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T H E

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THE NEW

BUILDER'S *Dictionary*:

OR,

Gentleman's and Architect's
COMPANION.

J A

I C

JAMBS? [in *Carpentry*] **J**AUMSS Door-Posts, also the upright Posts at the Ends of Window Frames.

JAMBS? [with *Bricklayers* **J**AUMSS &c.] the upright Sides of Chimneys, from the Hearth to the Mantle-Tree.

The Word is *Jambe* in *French* and signifies a Leg.

ICHNOGRAPHY [in *Architecture*] a Description or Draught of the Plat-Form or Ground-Work of a House or other Building. Or it is the Geometrical Place or Plat-Form of an Edifice or the Ground-Plot of an House or Building delineated upon Paper, describing the Form of the several Apartments, Rooms, Windows, Chimneys, &c. And this is properly the Business of the Master Ar-

chitect or Surveyor, being indeed the most abstruse and difficult of any.

ICHNOGRAPHY [in *Perspective*] is the View of any Thing cut off, by a Plane parallel to the Horizon, just at the Base or Bottom of it.

ICOSIHEDRON is a Solid Body contain'd under 20 equal and equilateral Triangles. Or,

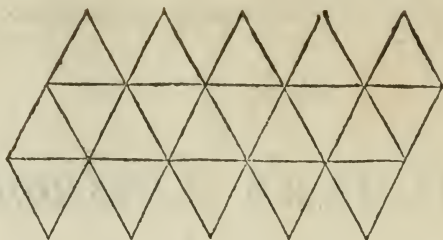
ICOSIHEDRON is a Solid, which consists of 20 triangular Pyramids, whose Vertices meet in the Centre of a Sphere, which is imagined to circumscribe it; and therefore have their Height and Bases equal. Wherefore the Solidity of one of these Pyramids being multiplied by 20, the Number of Bases, gives the solid Content of the Icosihedron.

A

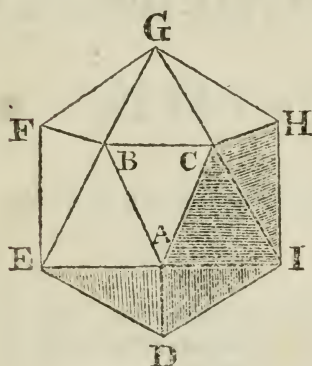
This

I C

I C



This Figure being drawn in ther, will represent an *Icosi-*
Past-Board, cut half through *dron*.
 and then folded up neatly toge-



Let A B C D E F G H I,
 be an Icosihedron, each Side
 of which is 12 Inches; the so-
 lid and superficial Content is
 requir'd.

The Icosihedron is compos'd
 of 20 triangular Pyramids, with
 their Vertices all joining in the
 Centre.

Therefore if the Solid Con-
 tent of one Pyramid be mul-
 tiply'd by 20, the Product is
 the whole Solid Content of the
 Icosihedron.

$$10 \cdot 39224$$

6

$$62 \cdot 35344$$

20

$$1247 - 06880$$

The third Part of the Alti-
 tude of the Pyramid.

$$30230456$$

$$4435326$$

$$181382736$$

$$6046091$$

$$906914$$

$$151152$$

$$9069$$

$$1209$$

$$121$$

$$188 - 497292$$

20

$$3769 - 945840$$

The Solidity.

The superficial Content

$$1147 - 0688.$$

A TABLE shewing the Solidity and superficial Content of any of the Regular Bodies, the Sides being 1 or Unity.

The Names of the Bodies	The Solidity	Superficies
Tetrahedron	0 - 1178511	1 · 732051
Octahedron	0 - 4714045	3 · 464102
Hexahedron	1 0000000	6 · 000000
Icosihedron	2 - 181695	8 · 660254
Dodecahedron	7 - 663119	20 · 645.729

By this Table the Content either Superficial or Solid, of any of these Bodies, may very readily be found; for all like Superficial Figures, are in Proportion one to another, as are the Squares of their like Sides; therefore it will be as the Square of 1 (which is 1) is to the Superficial Content in the Table, so is the Square of the Side of the like Body, to the Superficial Content of the same Body.

Therefore, if the Number in the Table be multiply'd by the Square of the Side given, the Product will be the Superficial Content requir'd.

All like Solids are in such Proportion to each other, as are the Cubes of their like Sides; therefore it will be as 1. (which is the Cube of 1.) is to the Solid Content in the Table, so is the Cube of the Side given to the Solid Content requir'd.

Therefore if the Number in the Table be multiply'd by the Cube of the given Side, the Product will be the Solid Content of the same Body.

JET D'EAU is a *French* Term, commonly us'd for a Fountain, which casts up Water to any considerable Height in the Air.

M. Mariote says a *Jet d'Eau* will never rise so high as its Reservatory; but always falls short of it by a Space, which is in a subduplicate Ratio of that Height; and this he proves by several Experiments.

He tells us also, that if a greater Branch is cut into many smaller Ones, or is distributed thro' several *Jets*, the Square of the Diameter of the main Pipe, must be proportioned to the Sum of all the Expences of its Branches, and particularly, that if the Reservatory be 52 Foot high, and the Adjutage half an Inch in Diameter, the Pipe ought to be 3 Inches in Diameter.

IMAGE [in *Opticks*] is the Appearance of an Object by Reflection or Refraction.

In all Plane Speculums, the Image appears of the same Magnitude as the Object, and as far behind the Speculum, as the Object is distant before it.

In Convex Speculums, the Image is farther distant from the Centre of the Convexity, than from the Point of Reflection, and the Image appears less than the Object.

IMPASTATION [in *Masonry*] a Term us'd for a Work made of Stuck or Stone, beaten and wrought up in Manner of a Paste.

IMPERFECT Numbers [in *Arithmetick*] are those whose Aliquot Parts taken together, don't make the just Number: but either come short of it, in which Case they are called *deficient Numbers*, or exceed it, and in this Case call'd *Abundant Numbers*.

IMPOSTS [in *Architecture*] are what are sometimes call'd Chaptrels; being the Parts on which the Feet of Arches stand.

These *Imposts* are conformable to their proper Orders.

The *Tuscan* has only a *Plinth*; the *Dorick* has 2 Faces crown'd: the *Ionick* a Larmier or Crown over the two Faces, and its Mouldings may be carved; the *Corinthian* and *Composite* have a Larmier Freeze, and other Mouldings.

The Projectures of the *Imposts* must not exceed the naked of the Pilaster.

Sometimes the Entablature of the Order, serves for the *Impost* of the Arch, and this has a very grand and stately Appearance.

The *Impost* is a Thing very essential to the Composition of the Ordonnances, insomuch that without it, in the Place where the Curve Line of the Arch

meets with the perpendicular Line of the Pillar, there always seems a kind of Elbow.

Mr. *Perrault* defines it the *Plinth of a little Cornish*, that crowns a Peer, and supports the first Stone, whence a Vault or Arch commences.

It derives its Name from the *Italian* *Imposto*, surcharg'd or burthen'd with, or laid upon.

M. *Le Clerc* defines *Imposts* to be little Cornishes, which terminate the Piedroits of Portico's, and are peculiarly appointed to receive the Extremes of their Arches, with their Archivolts or Head-Bands.

He tells us he usually proposes 2 Designs of *Imposts*, different in Height and Projecture; the lowest is for Portico's where the Columns have no Pedestals, and the other for Portico's where they have; that is, the little *Imposts* are for little Arches, and the large *Imposts* for large Ones; it being highly reasonable, that the Bigness of the *Impost* should be proportionable to that of the Portico.

He likewise observes, that Care must be taken that the *Impost* never exceed the Semi-Diameter of the Column behind; nor intercept any Thing of its roundness before.

He adds that the most perfect Arches of the *Ionick* Order, are those which consist of a Semi-Circle; and the *Imposts* are most usually plac'd on a Level with the Centre.

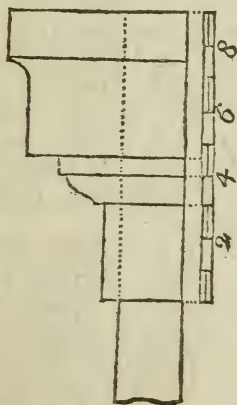
However there are some Architects, who from an optical Consideration, place them a few

Minute

Minutes lower; and 'tis with Judgment they do it; for as the Projecture of the Impost hides a little Part of the Arch from the Eye, 'tis but reasonable, that it should be lower'd a little, to leave the intire Semi-Circle in View, which otherwise would not appear in View.

Some late Authors have given the following Rules for dividing the *Imposts* of *Arches*, by the Proportions of equal Parts; any Height being given (for either of them) is divided into Nine Parts.

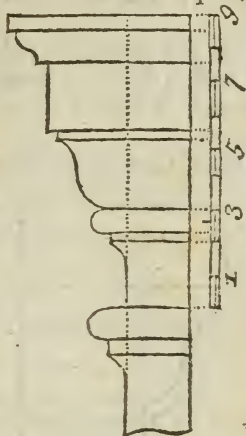
In the *Tuscan Impost*,



the *Facia* or *Band* hath 3, the *Ogee* 1, the *Fillet* $\frac{1}{2}$ a Part, the *Corona* 3, and the *Band* $1 \frac{1}{2}$.

For the *Projections*, the *Facia* hath $\frac{1}{2}$ a Part, the *Ogee* 2, the *Corona* 3, and the whole $3 \frac{1}{2}$. As in the Figure.

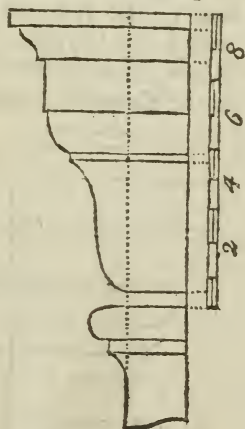
In the *Doric Impost*,



the *Frize* is 2, the *Fillet* $\frac{1}{4}$; the *Astragal* $\frac{3}{4}$, the *Scima Recta* $2 \frac{1}{4}$, the *Fillet* $\frac{1}{4}$, the *Corona* 2, the *Ogee* 1, and the *Fillet* $\frac{1}{2}$ a Part.

For the *Projections*, the *Fillet* hath $\frac{1}{2}$ a Part, the *Astragal* 1, the *Corona* $2 \frac{1}{2}$, and the *Whole* $3 \frac{1}{2}$. As in the Figure.

In the *Ionic Impost*,

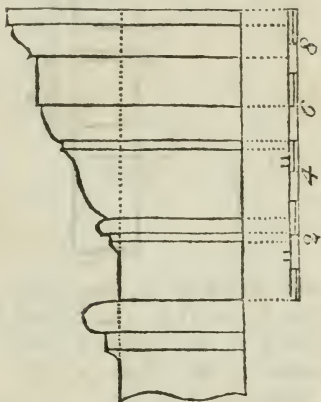


the *Fillet* hath $\frac{1}{2}$ a Part, the *Scima* 4, the *Fillet* $\frac{1}{4}$, the *Ovolo* $1 \frac{1}{4}$, the *Corona* $1 \frac{1}{2}$, the *Ogee* 2, and the *Whole* $3 \frac{1}{2}$.

Ogee 1, and the Fillet $\frac{1}{2}$ a Part.

For the *Projections* the Scima hath 1 $\frac{3}{4}$, the Corona 2 $\frac{1}{2}$, and the Whole 3 $\frac{1}{2}$, as in the Figure.

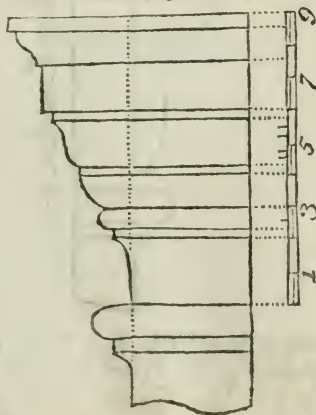
In the *Corinthian Impost*,



the Frize hath 1 $\frac{3}{4}$, the Fillet $\frac{1}{4}$, the Astragal $\frac{1}{2}$ a Part, the Scima 2 $\frac{1}{4}$, the Fillet $\frac{1}{4}$, the Ovolo 1, the Corona 1 $\frac{1}{2}$, the Ogee 1, and the Fillet $\frac{1}{2}$ a Part.

For the *Projections*, the Fillet hath $\frac{1}{4}$, the Astragal $\frac{3}{4}$, the Scima 1 $\frac{3}{4}$, the Corona 2 $\frac{1}{2}$, and the Whole 3 $\frac{1}{2}$, as in the Figure.

In the *Composite Impost*,



the Frize hath 2, the Fillet $\frac{1}{4}$, the Astragal $\frac{3}{4}$, the Ovolo 1, the Fillet $\frac{1}{4}$, the Scima 1 $\frac{1}{2}$, the Fillet $\frac{1}{4}$, the Corona 1 $\frac{1}{2}$, the Ogee 1, and the Fillet $\frac{1}{2}$ a Part.

For the *Projections*, the Fillet hath $\frac{1}{4}$, the Astragal $\frac{3}{4}$, the Ovolo 1 $\frac{1}{2}$, the Scima 2 $\frac{1}{4}$, the Corona 2 $\frac{1}{2}$, and the Whole, 3 $\frac{1}{2}$, as in the Figure.

The *Collerino* of each of the last 4 Orders is 1 of these Parts, and the Fillet $\frac{1}{2}$ a Part more.

For the *Projections*, the Fillet is $\frac{1}{2}$ a Part, and the Whole 1 and $\frac{1}{4}$.

IMPROPER FRACTIONS [in *Arithmetick*] are such as have their Numerators equal to, or greater than their Denominators as $\frac{3}{2}$ $\frac{5}{3}$ &c. which are not properly Fractions, but either whole or mixt Numbers, and are only put into the Form of *Fractions*, in Order to be added, subtracted, multiply'd or divided.

INCH is a known Measure, the twelfth Part of a Foot containing the Space of three Barly Corns in Length.

INCIDENCE Point [in *Opticks*] is that Point in which : Ray of Light is suppos'd to fall on a Piece of Glafs.

INCOMMENSURABLE Numbers [in *Arithmetick*] are such as have no common Divisor, that will divide them bot equally, as 3 and 5.

INCOMMENSURABLE Quantities [in *Geometry*] are those, which have no aliquot Part, or any common Measure that may measure them, as the Diagon

Diagonal and the Side of a Square; for altho' that each of these Lines have infinite aliquot Parts, as the half the Third, &c. yet not any Part of the one being ever so small, can possibly measure the other, as is demonstrated by *Euclid*. III. 117. El. 10. but yet is commensurable in Power.

INCOMPOSITE Numbers are the same with those *Euclid* calls Prime Numbers.

There is a Table of Incomposite Numbers in Dr. *Pell's* Edition of *Brancher's Algebra*, which not only gives an orderly Enumeration of all odd Numbers, which are not Composite; but it shews also that none of the Rest are so. This Table being useful, the Reader may have Reference to it.

INDETERMINED PROBLEM is one which is capable of an infinite Number of Answers, as to find 2 Numbers, whose Sum together with their Product shall be equal to a given Number, or to make a Rhomboides such, that the Rectangle under the Sides be equal to a given Square; both of which Problems, will have infinite Solutions.

INDIGO is a dark blue if work'd by it self; but it is usually mix'd with white to remedy this; and then it makes but a very faint blue; this Colour is the Tincture of a Vegetable call'd by that Name, and also *Anil*, and grows in both the West and East *Indies*, the Leaves of which being put into wooden Cisterns fill'd with Water, are often stirr'd violently, till the greatest Part be re-

duc'd to a Slime or Mucilage, which being separated from the Water, when sunk to the Bottom and dry'd, produces that Substance, which is by us call'd *Indigo*.

Indigo will grind very fine, and lie with a good Body, and is very much us'd in vulgar Painting.

Note, That the longer this Colour is ground, the more beautiful and fair it will look.

INDIVISIBLES [in *Geometry*] are such Elements or Principles as any Body or Figure may ultimately be resolv'd into: And these Elements or Indivisibles are in each peculiar Figure suppos'd to be infinitely small.

1. With Regard to which Notion, a Line may be said to consist of Points, a Surface of Parallel Lines, and a Solid of Parallel and Similar Surfaces: and then because each of these Elements is suppos'd to be indivisible, if in any Figure a Line be drawn thro' the Elements perpendicularly, the Number of Points in that Line, will be the same Number of Elements.

2. Whence we may see, that a *Parallelogram*, *Prism* or *Cylinder* is resolvable into Elements or Indivisibles, all equal to each other, parallel and like to the Base, a *Triangle* into Lines parallel to the Base, but decreasing in Arithmetical proportion, and so are the Circles which constitute the Parabolick Conoid, and these which constitute the Plane of a Circle of the Surface of an Isoscele, Cone.

3. A *Cylinder* may be resolv'd into Cylindrical Curve Surfaces, having all the same Height and continually decreasing inwards.

If a finite Quantity be divided by an infinitely small one, the Quotient will be an infinitely great one: and if a finite Quantity be multiply'd by an infinitely small one, the Product will be an infinitely small one.

But if by an infinitely great One, the Product will be an finite Quantity.

If an infinitely small Quantity be multiply'd or drawn into an infinitely great one, the Product will be a finite one.

INFINITELY INFINITE FRACTIONS, a Term us'd when all the Fractions, whose Numerator is 1. are together equal to an Unite; And hence it is deduc'd, that there are not only *infinite* Progressions, or Progressions *in infinitum*, but also *infinitely* farther than one Kind of Infinity.

That these infinitely infinite Progressions are notwithstanding computable, and to be brought into one Sum; and that not only finite; but into one so small, as to be less than any assignable Number: That of infinite Quantities Some are equal, others unequal: That one infinite Quantity may be equal to 2 or 3 or more Quantities, whether finite or infinite.

INFINITE or INFINITELY great QUANTITY, is that which has no Bounds, Ends or Limits.

INFINITELY SMALL QUANTITY, is that which is so very small, as to be incomparable to any finite Quantity, or which is less than any assignable Quantity.

1. No infinite Quantity can be augmented or lessen'd by adding to or taking from it a finite Quantity: Neither can a finite Quantity be augmented or lessen'd by adding to, or taking from it an infinitely small Quantity.

2. If there be 4 Proportionals, and the First is infinitely greater than the Second, then the Third must be infinitely greater than the Fourth.

INORDINATE PROPORTION is when the Order of Terms is disturb'd; as supposing 3 Magnitudes in one Rank, and 3 other proportional to them in another, and you compare them in a different Order; as suppose there are in one Rank these three Numbers 2, 3, 9; and in another Rank these other three 8, 24, 36; Proportional to the Precedent in a different Order, so that 2 shall be to 3 as 24 to 36, and 3 to 9 as 8 to 24, then casting away the mean Terms in each Rank conclude the first 2 in the first Rank is to the last 9, as 8 the first of the other Rank to the last 36.

INSCRIBED [in *Geometry*] a Figure is said to be inscrib'd in another, when all the Angles of the Figure inscrib'd touch either the Angles, Sides, or Planes of the other Figure.

INSULATED [*Insulatus*] is a Term apply'd to a Column that

that stands alone, or free from any contiguous Wall, &c. like an Island in the Sea. The *French* call it *Isolee*.

INTACTÆ are right Lines, to which curves do continually approach and yet never meet with them; these are usually called *Asymptotes*.

INTERCOLUMNIATION [in *Architecture*] is the Space between two Columns, which in the *Dorick* is regulated according to the Distribution of Ornaments in the Frieze; but in the other Orders, according to *Vitruvius*, is of five different Kinds, *viz.* *Picnostyle*, *Systyle*, *Eustyle*, *Diastyle* and *Aræostyle*. This is by the *Latins* call'd *Intercolumnium*.

M. *Le Clerc* says, that where the Columns of the *Tuscan* Order are without Pedestals, and without Porticoes too, there are three several Spaces or Distances, at which they may be plac'd, *viz.* a large, a mean, and a little Distance.

In the	{	<i>Tuscan</i>	The Interco-	{	4	Diameters of the						
		<i>Dorick</i>					lumniation must	3	Body of the Colum			
		<i>Ionick</i>								2	below.	
		<i>Corinthian</i>										2 $\frac{1}{4}$
		<i>Composite</i>										
be.												

The INTERCOLUMNS of the *Ionick* Order, M. *Le Clerc* says, that the Distances of this Order are adjusted by a certain Number of Denticles, which leave a convenient Space between them; with this Circumstance; that there is always found one in the Middle of each Column.

Thus, he says, when he

The first and second shew the greatest and least Space, which can be reasonably interpos'd between the Columns of the Order, when they follow each other one by one; and the third shews how near they may be plac'd, when they are to follow each other 2 by 2.

When those Columns stand 2 by 2, between each Pair the greatest Distance must be made, which is 9 Modules, reckoning from the Axis of the one to that of the other.

When they follow each other 1 by 1, the Interval ought not to exceed 4 Modules, 20 Minutes, from one Axis to the other.

It is not, he says, however to be suppos'd that these Proportions are so precise, as that they may not be varied a few Minutes when Occasion shall require; but this must be observ'd, that the less the Variation is, the better 'twill be.

mentions 35 Denticles between the Axes of the Columns, it is to be understood that there are 24 whole ones, and 2 halves, one at each Extream; the first *Denticles* and the last each being cut into 3 equal Parts by the Continuation of the Axis of the Columns.

Whence it may be observ'd, that in case there be a Necessity for

for augmenting or diminishing the Inter-columns, it must be done by augmenting or diminishing the Number of these *Denticles*, which however, ought never to exceed 1 or 2 *Denticles* at the most.

In the *Roman Order*. As in the *Ionick Order*, the Distances of the Columns are to be adjusted by a certain Number of *Denticles*; so, he says, in this Order, they must be adjusted by a certain Number of *Modillions*; with this Restriction, that there be always one exactly in the Middle between each Column.

The Inter-Modillions having been at first regulated by the Distance, that ought to be between the two Columns.

INTERSECTION [in *Mathematicks*] the cutting of one Line or Plane by another; thus we say, that the mutual Intersection of 2 Planes is a right Line.

INTERTIES } [in *Architecture*]
INTERDUCES }
are those smaller Pieces which lie Horizontally between the Sommers, or between them and the Sell and Raifon.

INTERVAL *Of the Fits of easy Reflection, and of easy*

Transmission of the Rays of Light. Is the Space between every Return of the Fit and the next Return. These Intervals Sir *Isaac Newton* shews how to collect, and thence to determine whether the Rays shall be reflected or transmitted at their subsequent incidence on any pellucid Medium.

INVERSION an Action by which any Thing is inverted or turn'd backwards. Problems in Geometry and Arithmetick are often proved by *Inversion* or making a contrary Rule or Demonstration.

JOBENTS, see *Nails*.

JOINT [in *Architecture*] is the Separation between the Stones, which is filled with Mortar, Plaister or Cement.

JOINT [in *Carpentry*, &c.] signifies the several Manners of Assembling of Pieces of Wood together, as a Dovetail-Joint, &c.

JOINT RULE, see *Rule*.

JOGGLE PIECE, see *Crown Post*.

JOISTS [in *Architecture*] are those Pieces of Timber fram'd into the Girders and Summers, on which the Boards of the Floors are laid.

Scantlings of Joists, at full Length (to bear in the Wall)

Being	{ 12 Foot	}	ought to	{ 8 Inches and 3 Inches	}				
	{ 11 Foot 6 Inches					}	be in their	{ 7 Inches and 3 Inches	}
	{ 10 Foot 6 Inches								

And binding or trimming Joists.

Being	{ 7 Foot	}	Ought to	{ 6 Inches and 5 Inches	}				
in	{ 9 Foot					}	be in their	{ 7 Inches and 5 Inches	}
Length	{ 11 or 12 Foot								

1. *Their Distance and Position*. 1. No Joists ought to lie at a greater Distance from each other, than 10 (or at most than 12) Inches.

2. All Joists on the Back of a Chimney, ought to be laid with a Trimmer, at 6 Inches Distance from the Back.

3. No Joists ought to bear at a longer Length than 10 Foot

4. No Joists ought to lie less than 8 Inches into the Brick-Wall.

5. Some Carpenters furr their Joists (as they call it) that is, they lay 2 Rows of Joists one over another; the undermost of which are fram'd Level with the under side of the Girder, and the uppermost (which lie cross the lower ones) lie Level with the upper side of the Girder.

JOINERY, the Art of working in Wood, or of fitting and assembling various Parts or Members together: It is call'd by the *French Menuiserie* q. d. Small Work, by which it is distinguish'd from *Carpentry*, which is conversant in larger and less curious Works.

Joiners Work.

JOINERS measure their Work by the Yard Square; but they take their Dimensions differently from others; for they have a Custom so to do, saying, *they ought to measure where the Plane touches*; and therefore in taking the Height of any Room, about which there is a Cornish, and swelling Panels and Mouldings; they with a String begin at the Top, and girt over all the Mouldings; which will make the Room to measure much higher than it is; and as for measuring about the Room, they only take it as it is upon the Floor.

Example 1. If a Room of Wainscot being girt downwards over the Mouldings) be 15 Feet 9 Inches high, and 126 Feet 3 Inches in Compass, how many Yards are contain'd in that Room?

Multiply the Compass by the Height, and the Product will be 1988 Feet, 5 Inches, 3 Parts; which being divided by 9, gives 220 Yards, and 8 Feet, the Answer.

Feet	Inches.
126	3
15	9
<hr/>	
630	
126	
63	: 1 : 6
31	: 6 : 9
3	: 9 : 0
<hr/>	
9)	1988 : 5 : 3

Answer 220 : 8 F2.

126	: 25
15	: 75
<hr/>	
63	125
88	375
63	125
126	25
<hr/>	
9)	19884375
<hr/>	
220	: 8

Example

Example 2. If a Room of Waincot be 16 Feet 3 Inches high (being girt over the Mouldings) and the Compass of the Room is 137 Feet 6 Inches, how many Yards does it contain.

F.	:	I.
137	:	6
16		3
830		
137		
34	:	4 : 6
9) 2234	:	4 : 6
248	:	2 : 0

Facit 248 Yards, 2 Feet.

Multiply 137 Feet 6 Inches, by 16 Feet 3 Inches, and the Product will be 2234 Feet, 4 Inches 6 Parts, which being divided by 9, the Quotient will be 248 Yards, and 2 Feet.

137.5
162.5
6875
2750
8250
1375
9) 2234.375
248 2

2. JOINERS Work, or Waincotting.

By Scale and Compasses.

For the *First Example*, Extend the Compasses from 9 to 126,25 and that Extent will reach from 15, 75, to 220, 9 Yards.

For the *Second Example*, Extend the Compasses from 9 to 137,5 and that Extent will reach from 16,25 to 248 Yards and about a Quarter.

In Joiner's Work it is to be observ'd, and that in measuring of Doors and Window-Shutters, and all such Work as is wrought on both Sides, they are paid for Work and half Work; so that in measuring all such Work, the Content is first to be Found, as

before, and half that Content must be added to it; and that Sum so added, will be the Content at Work and Half.

Example. If the Window-Shutters about the Room be 69 Feet 9 Inches broad, and 6 Feet 3 Inches high, how many Yards do they contain at Work and Half.

Multiply 69 Feet 9 Inches by 6 Feet 3 Inches, and the Product will be 435 Feet 11 Inches 3 Parts; the Half of which is 217 Feet 11 Inches 7 Parts; which being added together, the Sum will be 653 Feet 10 Inches and 10 Parts; which being divided by 9, the Quotient will be 72 Yards 5 Feet, the Content at Work and Half.

P.		L.
69	-	9
6	-	3
<hr/>		
418	-	6
17	-	3
<hr/>		
435	-	11 - 3
217	-	11 - 7
<hr/>		
9)653	-	10 - 10
<hr/>		

72 - 5

Facit 72 Yards, 5 Feet

$$\begin{array}{r} 69.75 \\ 6.25 \\ \hline \end{array}$$
$$\begin{array}{r} 34875 \\ 13250 \\ 41850 \\ \hline \end{array}$$
$$\begin{array}{r} 435.9375 \\ 217.9687 \\ \hline \end{array}$$
$$635.9062$$
By Scale and Compass.

Extend the Compasses from 9 to 69.75, and that Extent will reach from 6.25 to 48.4 Yards; the Half of which is 24.2, which being added together make 72.6 Yards, the Content at Work and Half.

Note, That Deductions are to be made for all Window-Lights; but Window-Boards Sopheta Boards and Cheeks, must be measured by themselves.

IONICK ORDER [in *Architecture*] is the third of the five Orders, and is a Kind of mean between the strong and delicate Orders. Its Capital is adorn'd with Volutes, and its Cornish with Denticles.

The Proportions of this Pillar as they are taken from the famous one in the Temple of *Fortuna Virilis* at *Rome*, now the Church of *St. Mary the Egyptian* are these.

1. The *Entire Order*, from the Superficies of the Area to the Cornice are 22 Modules, or 11 Diameters.

2. The *Column* with its Base contains 18 Modules.

3. The Entablature (i. e. the *Architrave*, *Frieze* and *Cornice*) contains 4 Modules.

4. The *Volute* of the Capital is of an Oval Form.

5. The Columns in this Order are often hollowed and furrowed with 24 Gutters, or Channels, call'd Flutes, these Flutings are not always Concave from the top of the Shaft to the bottom; but for that third of it next the Base, are fill'd up with a Kind of Rods or Canes, by the *French* call'd *Batons*, and in the other 2 thirds are left hollow, or striated in imitation of the Folds or Plaits of a Garment.

The first Idea of this Order was given by the People of *Jonica*, who according to *Vitruvius* form'd it on the Model of a young Woman, dress'd in her Hair, and of an elegant Shape; whereas the *Dorick* had been form'd on the Model of a strong, robust Man.

The *Jonick* Order is distinguish'd from the *Composite* in that it has none of the *Acanthus* Leaves in its Capital, and from

from the *Tuscan* and *Dorick* too, by the Channels or Fluting in its Shaft.

When this Order was first invented, its Height was but 16 Modules; but the Ancients to render it still more beautiful than the *Dorick*, augmented its Height by adding a Base to it, which was unknown to the *Dorick*.

M. *Le Clerc* makes its Entablement 4 Modules & 10 Minutes, and its Pedestal 6 intire Modules; so that the whole Order makes 28 Modules 10 Minutes.

It is said, that the Temple of *Diana* at *Ephesus*, the most celebrated Edifice of all Antiquity, was of this Order.

This Order is at present us'd properly in Churches and religious Houses, Courts of Justice, and other Places of Tranquillity and Devotion.

This Order has one Advantage above any of the Rest which consists in this, that the fore and hind parts of its Capital are different from its Sides; but this is attended with an Inconvenience, when the Ordonnance is to turn from the Front of the Building to the Side: To obviate which the Capital may be made Angular, as is done in the Temple of *Fortuna Virilis*.

Scamozzi and some other modern Architects have introduc'd the upper Part of the Composite Capital in Lieu of the *Ionick*; imitating that of the Temple of *Concord*, the 4 Sides of which are alike, in Order to render it more beau-

tiful, the Volute may be made a little more Oval and inclining.

The Proportions of the *Ionick* Order by equal Parts, are given by some late Authors as follows.

The whole Height is divided into 13 Diameters and a half; the Pedestal having two and two thirds, the Column nine, and the Entablature one and four fifths.

The Height of the Pedestal being 2 Diameters and $\frac{2}{3}$, is divided into 4, giving 1 to the Base, whose Plinth is $\frac{2}{3}$ thereof, the other Part is divided into 8, giving 1 to the Fillet, 4 to the Cymase, 1 to the Fillet, and 2 to the Hollow, the breadth of the Die, is 1 Diameter and $\frac{1}{3}$, and the Projection of the Base is equal to its Height, the upper Fillet hath 3 of these Parts, and the lower Fillet 7; the Height of the Cornice is half the Base, being $\frac{1}{2}$ of the whole Height, and is divided into 10, giving 2 to the Hollow, 1 to the Fillet, 4 to the Corona, 2 to the Ogee, and 1 to the Fillet; the Projection of the Hollow hath 3 of these Parts, the Corona 6, and the whole 8.

The Base of the Column, the Height is $\frac{1}{2}$ a Diameter, and is divided into 6, giving 1 and $\frac{3}{4}$ to the Plinth, 1 and $\frac{1}{4}$ to the lower Torus, $\frac{1}{4}$ to the Fillet, 1 to the Scotia, $\frac{1}{4}$ to the Fillet, 1 to the upper Torus, and $\frac{1}{2}$ a Part to the Bead ^b at Top; the Fillet above the Bead is equal to the others, and is Part of the Column; the Projection is 2 of these Parts, $\frac{1}{2}$ thereof is for the

the upper Fillet, and $\frac{2}{3}$ for the upper Torus; the Scotia is form'd by the Rule shewn in the *Doric*.

The DIMINISHING of this Column, is $\frac{1}{8}$ of the Diameter.

For the *Capital*, divide the Diameter into 9 Parts, and 4 and $\frac{3}{4}$ is the whole Height, giving 1 and $\frac{1}{4}$ from the bottom of the Volutes ^c to the Fillet, $\frac{1}{4}$ to the Fillet, $\frac{1}{2}$ a Part to the Astragal ^d, 1 to the Ovolo ^e, $\frac{3}{4}$ to the Volute, $\frac{1}{4}$ to the Rim ^f, $\frac{1}{2}$ a Part to the Ogee, and $\frac{1}{4}$ to the Fillet.

The *Projection* of the Ogee is 1 of these Parts. For forming the *Volute* describe a Circle in the Centre of the Astragal, equal to the Height thereof, and make the Divisions into 3, as is shewn in the Figure A, then placing one foot of the Compasses in the Centre marked 1, extend the other to the top of the Rim, and describe a quarter of a Circle, and removing the foot into the Centre 2, describe another Quarter, and so proceeding to all the rest as they are marked. For the *Diminishing* of the *Rim*, each Distance between the Centres is divided into five, and the nearest Division within the old ones, is the new Centre for the same.

The Height of the *Entablature* being 1 Diameter and $\frac{4}{5}$ is

divided into 6, 2 are for the Architrave 1, and $\frac{1}{2}$ for the Frize, and 2 $\frac{1}{2}$ for the Cornice.

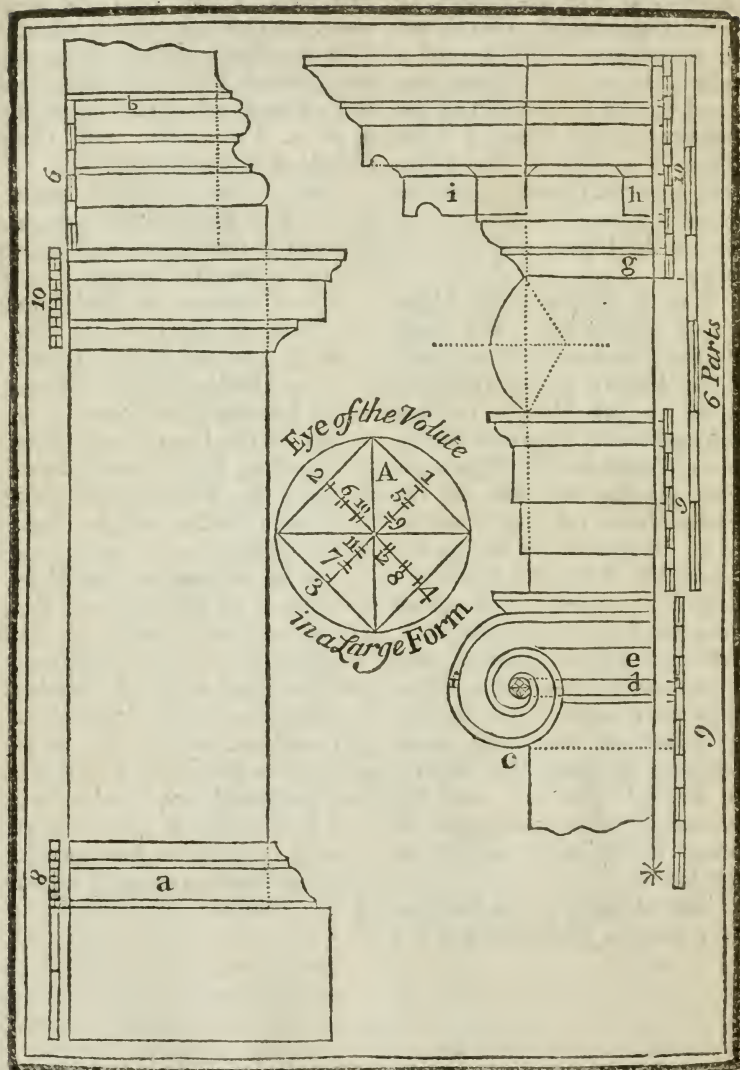
The *Architrave* is divided into 9, giving 1 and $\frac{3}{4}$ to the first Face, 2 and $\frac{1}{2}$ to the second, and 3 to the third, 1 and $\frac{1}{4}$ to the Ogee, and $\frac{1}{2}$ a Part to the Fillet: The *Projection* of the 2d and 3d Faces have a $\frac{1}{4}$ of a Part each, and the Whole 2 of these Parts.

The *Frize* is formed with such a Part of the Circle which answers to the Naked and Projection of the Architrave.

The *Cornice* is divided into 10 Parts, giving 1 to the Cavetto ^g, $\frac{1}{4}$ to the Fillet, 1 and $\frac{1}{4}$ to the Ovolo, $\frac{1}{4}$ to the Fillet, 2 and $\frac{3}{4}$ to the Modillions, ^h, $\frac{1}{2}$ 1 Part to the Caps, 1 and $\frac{3}{4}$ to the Corona, $\frac{3}{4}$ to Scima Reverfa, $\frac{1}{4}$ to the Fillet, 1 and $\frac{3}{4}$ to the Scima Recta, and $\frac{1}{2}$ a Part to the Fillet.

For the *Projections* the Hollow has 1 of these Parts, the Ovolo 2; the breadth of the *Modillion* is $\frac{5}{8}$ of the Diameter, and the inside is Perpendicular to the Naked of the Column at top, and one being in the middle, gives the Space between; the Return'd one ⁱ projects 5 and $\frac{1}{2}$, the Cap 6, the Corona 7 and $\frac{1}{2}$, the Scima Reverfa 8 $\frac{1}{4}$, and the Whole 10, being equal to the Height.

The Proportions of the Ionic Order, by equal Parts.



IRON is a hard fusible and malleable Metal, of vast Use in Building, and many other Affairs in Life.

It consists of an Earth, Salt, and Sulphur; but all impure, ill mix'd and digested, which renders it very liable to Rust.

It is the hardest, driest, and most difficult to be melted of all Metals.

It may be softened, by heating it often in the Fire, hammering it, and letting it cool of it self; and is hardened by extinguishing it in Water.

It may be rendered white by cooling it in Sal Armoniac and quick Lime.

The strongest Temper of *Iron*, is said to be that, which it takes in the Juice of strain'd Worms.

Iron has a great Conformity with Copper, so that they are not easily separated when soldred together.

Iron has also a great Conformity with the Loadstone. *Robault* says, that it is it self an imperfect Loadstone, and that if it be a long Time exposed in a certain situation, it becomes a real Loadstone, and mentions the Iron in the Steeple of *Notre-Dame* at *Chartres* as an Instance.

[The Kinds of *Iron*.] There are several Kinds of Iron that have Properties very different from one another; as,

1. *English*, Which is coarse, hard and brittle, fit for Fire Bars, and other such coarse Uses.

2. *Swedish Iron*, which of all others, is the best, us'd in

England. It is a fine, tough sort of Iron, which will best endure the Hammer, is softest to File, and in all Respects the best to Work upon; and therefore most coveted by Workmen.

3. *Spanish Iron*, which would be as good as the *Swedish*, were it not subject to *Red-Sear*, (as Workmen phrase it) that is, to crack between hot and cold; therefore when it falls under your Hands, you must tend it more diligently at the Forge. But tho' it be a good, tough, soft Iron, yet Workmen refuse it for many Uses, because 'tis so ill and unevenly wrought in the Bars, that it costs them a great Deal of Labour to smooth it; but it is good for all great Works, which require Welding, as the Bodies of Anvils, Sledges, large Bell-Clappers, large Pestles for Mortars, and all thick strong Bars, &c. But it is particularly chosen by Anchor Smiths, because it abides the Heat better than other Iron, and when 'tis well wrought, is the toughest.

4. *German Iron*, which goes by the Name of *Dort Square*, because it is brought hither from thence, and is wrought into Bars of 3 Quarters of an Inch Square; this is a bad, coarse Iron, and only fit for ordinary Uses, as Window-Bars, Brewers Bars, Fire Bars, &c.

5. There is another Sort of Iron for making of Wire, which is the softest and toughest of all Iron. This Sort is not peculiar to any Country; but is indifferently made, wherever Iron is

made, tho' of the worst Sort ; for 'tis the first Sort that runs from the Mine Stone, and is reserv'd purely for the making of Wire.

To know good Iron.] Generally speaking, the best Iron is the softest and toughest, and that which when it breaks is of an even greyish Colour, without any of those glittering Specks, or any Flaws or Divisions, like to those seen in broken Antimony.

Therefore when you chuse it, chuse such as bows ofteneft before it breaks, which is an Argument of toughness, and see that it breaks sound within, of a greyish Colour, &c. And that there be no Flaws or Divisions in it ; for these are Arguments that 'tis sound, and has been well wrought at the Mill.

To give Iron a true blue Colour.] Rub off the black Scurf with a Grind-Stone or Whet-Stone, rubbing hard upon the Work: then heat it in the Fire, and as it grows hot, it will change the Colour by Degrees, becoming first of a light Gold Colour, then of a darker Gold Colour, and then of a beautiful Blue. But sometimes Work-men Grind Indigo and Sallad-Oil together, and rub the Mixture upon it with a Woollen Rag, while it is heating, and let it cool of it self.

Of Twisting Iron.] Square and flat Bars of Iron are sometimes (by Smiths) twisted for Ornament, which is very easily done, and the Manner of doing it is as follows: After the Bar

is square or flat forged (and if the Curiosity of the Work require it, truly fil'd) they give it a *Flame Heat* ; or if the Work be small, but a *Blood red Heat*, and then it is easily twisted about as much or as little as they please, with the Tongues, Vice, or the like.

The Price of Iron when wrought.] Iron being wrought by the Smith into Dogs, Bars, Staples, large Hooks, Hinges, Grates, &c. the usual Price is $3\frac{1}{2}d.$ or $4d.$ per Pound: But for small and neat Hooks, Hinges, Bolts, Staples, &c. various, as from $4d.$ to $8d.$ per Pound.

The several Heats which the Smiths give their Iron in working are,

1. A *Sparkling or Welding Heat*, which is used when they double up their Iron, or weld 2 Pieces of Iron together End to End.

2. A *Flame or White Heat*, which is us'd when the Iron has not its Form or Size, but must be forg'd into both.

3. *Blood Red Heat*, which is used when the Iron has already its Form and Size, but wants a little Hammering to smooth and fit it for the File.

If the Iron be made too Hot, it will red-scar, *i. e.* break or crackle under the Hammer while it is working between hot and cold.

IRON-MOULDS, are certain Yellow Lumps of Earth or Stone, found in Chalk-Pits, about the *Chiltern* in *Oxfordshire*, which are really a Kind of indigested Iron Ore.

IRON-ORES } Of these
 IRON-WORKS } we have
 a great Number in most Parts
 of *England*; but those in the
Forest of Dean in *Glocestershire*,
 are in the most Repute.

The Ore is there found in
 great Abundance, differing
 much in Colour, Weight, and
 Goodness.

The best, which is called
Bruss Ore, is of a Blueish
 Colour, very ponderous, and full
 of little shining Specks, like
 Grains of Silver: This affords
 the greatest Quantity of Iron;
 but being melted alone, pro-
 duces a Metal very short and
 brittle, and therefore not so fit
 for common Use.

In Order to remedy this In-
 convenience, the Workmen use
 another Sort of Material call'd
Cinders, which is no other
 than the Refuse of the Ore,
 after the Metal has been ex-
 tracted; and which being ming-
 led with the other in due Quan-
 tity, gives it an excellent Tem-
 per of Toughness, which makes
 this *Iron* to be preferred before
 any other brought from Foreign
 Parts.

After the Ore is Provided,
 the first Work is to Calcine it,
 which is done in Kilns, much
 after the Fashion of our Com-
 mon Lime Kilns; which are
 filled up to the Top with Coal
 and Ore, *Stratum super Stra-*
tum, i. e. Layer upon Layer;
 and then setting Fire to the
 Bottom, they let it burn 'till
 the Coal is wasted, and then
 renew the Kiln with fresh Ore
 and Coals, in the same Manner
 as before.

This is perform'd without
 fusing the Metal, and serves to
 consume the more drossy Part
 of the Ore, and to make it
 malleable, supplying the bea-
 ting and washing that are us'd
 in other Metals.

From thence they carry it to
 the Furnaces, which are built
 either of Brick or Stone, about
 24 Foot Square on the outside,
 and near 30 Foot in Height
 within: not above 8 or 10 Foot
 over where it is the widest,
 which is about the middle; the
 Top and Bottom having a nar-
 row Compass, much like the
 Shape of an Egg.

Behind the Furnace are fix'd
 2 Pair of Bellows, the Noses
 of which meet at a little Hole
 near the Bottom; these are
 compress'd together by certain
 Buttons, plac'd on the Axis of
 a very large Wheel, which is
 turn'd about by Water, in the
 Manner of an overshot Mill.

As soon as these Buttons are
 slid off, the Bellows are rais'd
 again by the Counterpoise of
 Weights, whereby they are
 made to play alternately, the
 one giving its Blast, the time
 the other is rising.

At first, these Furnaces are
 fill'd with Ore and Cinder in-
 termix'd with Fuel, which in
 these Works is always of Char-
 coal, laying them hollow at
 the Bottom, that they may take
 Fire more easily; but after
 they are once kindled, the Ma-
 terials run together into a hard
 Cake or Lump, which is sus-
 tain'd by the Fashion of the
 Furnace; and through this the
 Metal, as it were, meets, trickles

down into the Receivers set at the Bottom, where there is a Passage open, by which the Men take away the Scum and Dross, and let out the Metal, as they see Occasion.

Before the Mouth of the Furnace lies a great Bed of Sand, where they make Furrows of the Shape in o which they would have the *I on* cast.

As soon as the Receivers are full, they let in the Metal, which is rendred so very fluid by the Violence of the Fire, that it not only runs to a considerable Distance, but stands afterwards boiling for a good while.

When the Furnaces are once set to work, they are kept constantly employ'd for many Months together, the Fire not being suffer'd to slacken Day nor Night, but is kept still supply'd with Fuel and other Materials poured on at Top as the other wastes. The Coal us'd in this Work is altogether Charcoal, for Sea-Coal will not do.

The Workmen bring their Sows and Pigs of Iron from these Furnaces to the Forges, where they are wrought into Bars.

IRRATIONAL Numbers are the same as *Surd Numbers*.

IRREGULAR BODIES, are such Solids as are not terminated by equal and regular Surfaces.

IRREGULAR COLUMN [in *Architecture*] is one which does not only deviate from the Proportions of any of the 5 Orders; but whose Ornaments, whether in the Shaft or Capital, are absurd and ill chosen.

ISAGON [in *Geometry*] is sometimes us'd for a Figure, consisting of equal Angles.

ISLES [in *Architecture*] are the Sides or Wings of a Building.

ISOCHROME Vibrations of a Pendulum, are such as are made in the same Space of Time, as all the Vibrations or Springs of the same Pendulum are; whether the Ark it describes be longer or shorter; for when it describes a shorter Ark, it moves so much the slower, and when a long one, proportionably faster.

ISOCHRONAL LINE, is that in which a heavy Body is suppos'd to descend without any Acceleration.

ISOPERIMETRICAL Figures [in *Geometry*] are such as have equal Perimeters or Circumferences.

1. Of *Isoperimetrical regular Figures*, that is the greatest that contains the greatest Number of Sides, or most Angles, and consequently a Circle is the greatest of all Figures that have the same Ambit as it has.

2. Of 2 *Isoperimetrical Triangles*, having the same Base, whereof 2 Sides of one are equal, and the other unequal, that is the greater, whose Sides are equal.

3. Of *Isoperimetrical Figures* whose Sides are equal in Number, that is the greatest which is equilateral and equiangular.

ISOSCELES TRIANGLE is a Triangle that hath 2 Sides, or Legs equal to one another, and the third Side or Base unequal; as in the Figure.



JUFFERS [with *Carpenters*] a Term us'd for Stuff, about 4 or 5 Inches Square, and of several Lengths.

K.

KERF is the sawn away slit in a Piece of Timber or Board; or the Way made by the Saw, is call'd a Kerf.

KEY-STONE, See *Arch*.

KEYS for Doors are of various Prices, according to their Size and Workmanship, Master Keys *per* piece; 2 or 3 s.

KEYS [in *Masonry*] that have a Projecture, and are made in Manner of Consoles, and plac'd in the middle of Arches or Portico's, are particularly design'd to sustain the Weight and Pressure of the Entablature, where it happens to be very great between the Columns; for this Reason they ought to be made in such Manner, as that they may prove a real Support, and not stand for mere Ornaments, as they frequently do. Without this Precaution, *M. Le Clerc* says, he thinks they had better be entirely omitted.

KING-PIECE, See *Crown-Post*.

KNEE, a Piece of Timber cut crooked with an Angle, is call'd a *Knee-Piece* or *Knee-Rafter*.

L.

LABEL, is a long, thin brass Ruler, with a small Sight at one End, and a Center Hole at the other; commonly us'd with a tangent Line to the Edge of a Circumferentor for taking Altitudes, &c.

LABORATORY, a Place where Chymists Furnaces are built, their Vessels kept, and their Operations perform'd.

LABYRINTH, a large intricate Edifice, cut out into various Isles, Meanders, running into one another, so as to render it difficult to get out of it.

There is mention made of four celebrated Labyrinths of Antiquity; that of *Crete* is the most famous, built by *Dædalus*, out of which *Theseus* is said to have made his Escape by Means of *Ariadre's* Crew.

2. That of *Egypt*, which according to *Pliny* was the oldest of all, and was standing in his Time, having stood 3600 Years, which, *Herodotus* says, was the Work of several Kings, but *Pliny* ascribes it to King *Petefucus* or *Tirheos*. It stood on the Banks of the Lake *Myris*, and consisted of 12 Palaces and 1500 Apartments; *Mela* says 3000 Houses.

3. That of *Lemnos*, which was supported by Columns of wonderful Beauty; of which there were some Remains in *Pliny's* Time.

4. That of *Italy*, built by *Porfenna* King of *Utruria* for his Tomb.

LACUNAR [in *Architecture*] an arched Roof or Ceiling, more especially the Planking or Flooring above the Portico's and Piazza's.

LAKE, especially the richest Sorts, is the best of all dark Reds, being a most pure crimson; 'tis a Colour that will grind very fine, and lies with a good Body; but there must be much Pains taken in grinding it; for if it be not well and thoroughly ground, its Colour will want much of its Glory; and besides this, 'twill work with some Difficulty; being apt to cling together like a Jelly, after 'tis laid on; just as warm Water does upon a greasy Trencher, when it is wash'd in it; to prevent which, it must be well ground, and tempered as thin, as it can well be work'd.

There are several Sorts of *Lake* sold at the Colour Shops, very different, some being of a more dead and pale Colour.

It is made of the Tincture of a Vegetable, which stains red; but of what, or how done, I have not yet perfectly learn'd: the best Sorts of it come from *Venice* and *Florence*.

LANTHORN [in *Architecture*] a Sort of little Dome rais'd over the Roof of a Building to give Light, and to serve for a *Corona*, or to finish the Building; the Term is also us'd for a square Cage of Carpentry, with Glafs in it, placed over the Ridge of a Corridor or a Gallery, between 2 Rows of Shops, to illumine them, as that in the *Royal Exchange, London*.

LARMIER [in *Architecture*] A flat, Square, massive Member of the Cornice, between the *Cymatium*, and the *Ovolo*, and jêts out farthest, being so call'd from its Use, which is to disperse the Water, and cause it to fall at a Distance from the Wall, drop by drop, or as it were, by Tears, *Larme* in *French* signifying a Tear; the *Larmier* is also call'd *Corona*.

LATCHES for Doors are of various Kinds and Prices; common Iron Latches *per* piece, 6d. larger, 8d. and 10d. Long varnish'd Latches, at about 10d. *per* piece, Rim'd Latches with a sliding Bolt, 2s. *per* piece. Spring Latches, 1 or 1s. and 6d *per* piece.

LATHS [for Building] long thin and narrow slips of Wood, us'd in Tiling or Walling; these are distinguish'd into 3 Kinds, according to the different Woods they are made of, *viz.* Heart of Oak, Sap-Laths, and Deal-Laths; the 2 last Sorts are us'd for Ceilings and Partitioning, and the first for Tiling only.

Again, Laths are distinguish'd into 3 Kinds more, in Respect to their Lengths, *viz.* into 5 foot, 4 foot, and 3 foot Laths; tho' the Statute allows but of 2 Lengths, *viz.* those of 5 foot and of 3 foot, each of which are to be 4 Inch and half in breadth, and half an Inch in thickness.

All these Sorts of Laths are necessary, (especially in repairing of old Buildings) because all Rafters are not spac'd alike, nor yet the Proportion strictly observ'd in every one and the same Roof.

Bundle of Laths.] A Bundle of Laths is so many as are bound up together, and is generally call'd a hundred of Laths; tho' of the 3 foot Laths there goes 7 Score or 140 to the hundred or Bundle, and of the 4 foot Laths, 6 Score, but of 5 foot Laths, there goes but just 5 Score to the hundred or Bundle.

The Size of Laths.] The Statute allows but of 2 Sorts of Laths, one of 5 foot, and the other of 4 foot in Length; of either Sort each Lath ought to be in Breadth an Inch and half, and in thickness, half an Inch; but they are commonly less, and are seldom exact, either in their Tales or Measures.

Of Cleaving Laths.] Lath-cleavers having cut their Timber into Lengths, they cleave each piece (with Wedges) into 8, 12 or 16 pieces (according to the largeness of their Timber) which they call *Bolts*; (with their Dowl-Ax) by the *Felt Grain* [which is that Grain which is seen to run round in Rings at the End of a Tree] into Sizes for the Breadth of their Laths, and this Work they call *Felting*.

Then lastly (with their Chit) they cleave their Laths into their thicknesses, by the *Quarter Grain*, which is that Grain which is seen to run in strait Lines towards the Pith.

Some say a Foot of Timber will make a Bundle of a hundred Laths; but this is not true, unless the Laths be made very slight: It has been found by many Experiments, that 40

Foot of Oaken round Timber will not make above 30 hundred, of which Number above 1 third part, *viz.* above 10 hundred will be Sap-Laths.

The Price of Laths.] The common price for cleaving of Laths, is 5*d* or 6*d* per Bundle, tho' some have said, they have had them made in *Sussex* for 4½*d* the Bundle.

The Price of Laths must of Necessity be various, there being so great a Disparity in them; not only as to their Goodness, but likewise as to their Plenty and Scarcity. But the Prices are generally between 1*s.* and 2*s.* 6*d.* a Bundle: And the common Rate for *Heart Laths* is about 20*d.* and *Sap Laths* ⅔ of their Price.

Laths are sometimes sold for 4*l.* 10*s.* the Carriage of 60 Bundles, 40 of which have been *Heart Laths*, and 20 *Sap Laths*, at which Rate (reckoning *Sap-Laths* to be ⅔ of the Price of *Heart Laths*) the *Heart Laths* were sold for 20 ⅓ per Bundle, and the *Sap Laths* at 13½*d.*

The Nails allow'd to a Bundle of Laths.] The common allowance is 5 hundred (at 6 Score to the hundred, which is 600) Nails to a Bundle of Laths.

How many Laths to a Square.] Workmen commonly allow a Bundle of Laths to a Square of Tiling, which (if the Distances of the Rafters fit the Lengths of the Laths without any waste) is a sufficient Allowance; for then about 90, five foot, and 112, four foot Laths will compleat a Square of Tiling. Counter Laths, and all

at 7 Inches Gage, and at 8 Inches Gage, a Square, will not require so many.

LATHING. The Price of Lathing, Plaistering, rendring and washing with Size, is about 10*d.* 12*d.* or 14*d.* the Yard, for Materials and Work.

LATION, is the Translation or Motion of a Body from one Place to another in a right Line.

LATUS RECTUM [in *Conicks*] the same as Parameter.

LAZARETTO } a public

LAZAR-HOUSE } sick Building in Form of an Hospital for the Reception of poor sick Persons. It is usually a large Building at a Distance from any City, whose Apartments stand at a Distance from each other. In some Countries they are appointed for Persons who come from Places suspected of the Plague to Quarantine; and where Ships are unladen and their Equipage is laid up for 40 Days, more or less, according to the Time and Place of Departure.

LEAD is a coarse, heavy, and impure Metal, of all others the softest and most fusible, when refin'd; those who have analys'd it, find it contains a little Mercury, some Sulphur, and a great Deal of Bituminous Earth.

Lead is found in various Countries, but most plentifully in *England*. It is likewise found in several Kinds of Soils and Stones, some of which contain besides Gold, some Silver and others Tin. &c.

It is melted in a Furnace

provided for that Purpose, with a strong Coal Fire upon it. As it melts, it runs through a Canal on one Side of it, leaving the Earth, Stone and Scoria with the Ashes of the Coals.

It is purified by Skimming it before it is cold, and by throwing Suet and other fat Bodies into it: Some able Naturalists have observ'd, that Lead increases in Weight, either in the open Air, or under Ground.

Mr. *Boyle* observes this particularly of the Lead of Churches, which, he says, grows frequently both in Bulk and Weight, so as to become too ponderous for the Timber that before sustain'd it; which some account for from the Impurity, Hetero - Geneity, and loose Texture of its Parts, by means of which the Particles of the Air getting Admission within its Pores, are attracted and easily assimilated to it.

But others who rely wholly on Experience, absolutely deny the Effect, as also that it is reproduc'd in Mines before exhausted, by letting them lie long open to the Air, which others assert.

Lead is found of a lighter or deeper Colour, accordingly as it is more or less purified, tho' some make a Difference in the Colour of the Ore, always esteeming that most which is the whitest.

Lead is much us'd in Building, especially for Coverings, Gutters, Pipes and Glazing.

Lead is either cast into Sheets in a Mold, or mill'd, which last is found by much the

the least serviceable, not only on Account of its thinness; but also because 'tis so exceedingly stretch'd in milling, that when it comes to lie in the hot Sun, it shrinks and cracks, and of Consequence will not keep out the Water.

The *Lead* us'd by *Glasiers* is first cast into slender Rods, 12 or 14 Inches long, call'd *Canes*, which being afterwards drawn thro' their Vice, comes to have a Groove on either Side for the Panes of Glass, and this they call *turn'd Lead*.

There are 3 Sorts of *Lead*, white, black, and ash-colour'd, the white is more perfect and precious than the black, and the Ash colour between both.

Of casting Sheet Lead.] To do this, there is a Mould provided, which is something longer than the Sheets are intended to be, that the End where the Metal runs off from the Mould may be cut off, because 'tis commonly thin and uneven, or ragged at the End.

This Mould which is the exact Breadth that the Sheets are to be, must stand very even or level in Breadth, and something falling from the End where the Metal is pour'd in, *viz.* about an Inch or Inch and half in the Length of 16 or 17 Feet.

This Mould usually consists of several Treffels, upon which Boards are laid and nail'd down fast, and upon these at a due Distance (according to the intended Breadth of the Sheets) the Sharps are fix'd.

These Sharps are 2 Pieces of

well season'd Timber, of about 4 Inches Square, and 16, 17 or 18 Foot in Length, according to the Size of the Sheets.

But some having found an inconveniency in this Method of fixing down the Shafts, they only fix one of the Sharps firmly, nailing the other on but slightly, and then they fix several Pieces firmly to the Boards, without the slightly fix'd Sharps, betwixt which and the Sharp they drive Wedges, to make the Sharps come nearer together, as they see Occasion; they having found by Experience, that the moistened Sand (when it has lain a while on the Boards) makes the Boards swell so much, that notwithstanding the Nails, the Sharps will be too far asunder.

At the upper End of the Mould stands the *Pan*, which is a Concave Triangular *Prism*, compos'd of 2 Planks nail'd together at right Angles to each other, and 2 triangular Pieces fitted in betwixt them at the Ends.

The Length of this *Pan* is the whole Breadth of the Mould in which the Sheets are cast, and the Breadth of the Planks of which 'tis compos'd, may be about 12 or 14 Inches, or more, according to the Quantity of Lead they have Occasion to put into it to make a Sheet of, and the thickness of the Planks an Inch and a half.

This *Pan* stands with its Bottom (which is a sharp Edge) on a Form at the End of the Mould, leaning with one Side against

against it, and on the opposite Side is a Handle to lift it up by, to pour out the melted Lead; and on that Side of the Pan next the Mould, are 2 Iron Hooks to take hold of the Mould, and prevent the Pan from slipping, when they pour the melted Lead out of it into the Mould.

This *Pan* is lin'd on the Inside with moisten'd Sand, to prevent it from being fired by the hot Metal.

The Mould is also fill'd up (from the upper End towards the lower End about $\frac{2}{3}$ parts of the Way with Sand sifted and moistened, after which a Man gets upon it, and treads it all over, with his Shoes on, to make it settle close to the Mould.

This being done, they begin to strike it Level with the *Strike*, which is a Piece of Board about 5 Inches broad, in the middle of which and towards the upper Edge is a wooden Pin (about 5 or 6 Inches long, and 1 or $1\frac{1}{4}$ Diameter) to hold it by when they use it.

The Length of this *Strike* is something more than the Breadth of the Mould on the Inside, and at each End is cut a Notch on the under Edge, about 2 Inches deep; so that when the *Strike* is us'd, it rides upon the Sharps with those Notches, and the lower Edge of the *Strike* rides about 2 Inches below the upper Side of the Sharps.

Then in levelling the Sand with the *Strike*, they begin to-

wards the lower End of that Part of the Mould that was fill'd, and taking the Handle of the *Strike* in their right Hand, and laying the left Hand upon one End of it, they draw the Sand back into that Part of the Mould that was empty.

Then they begin again a little nearer to the upper End, and draw the Sand back (as before) but not so far as the empty Part of the Mould; so that when it is thus levell'd the whole Length of the Mould, there are as many Places which seem to be unlevell'd as there are levell'd, by Reason of the Sand which is a little drawn back.

The next Operation is to draw all the loose and Hover Sand (rais'd in the last levelling) into the empty Part of the Mould; to do which they begin at the upper End of the Mould, and still as the Sand is drawn back, the levell'd Part must be examin'd to see that there be no Cavities in it; which if there be, a little Sand must be put into them, and that must be settled close and fast in the Cavities, by lifting up one End of the *Strike* (letting the other rest upon the other Sharp) and rapping upon the loose Sand which was put into the Cavities, and this will settle it close and fast.

When this has been done all over the upper $\frac{2}{3}$ Parts of the Mould, and all the loose Sand has been drawn back into the lower $\frac{1}{3}$ Part of the Mould, that is also trampled and settled

all over, and levell'd in all Respects as the other $\frac{2}{3}$ were, and its loose Sand is drawn off the Mould down into a Place 2 or 3 Inches below the lower End of the Mould, where the Sand is made into 2 Cavities to receive the overplus of the Lead.

The Sand being thus levell'd, the next Thing to be done is to smoothen it all over with a *smoothing Plane* (as they call it) which is a thick Plate of polish'd Brass, about 9 Inches Square, a little turn'd up on all the 4 Edges, so that the Underside looks somewhat like a Diamond cut Looking-Glass, on the upper Side, (which is a little Concave, like a Latten Pan) is a brass Handle solder'd on, upon which is a wooden one also, like a Case-smoothing Iron.

With this Instrument they smoothen the Sand all over, putting a little Sand in, where there are any small Cavities.

The Sand being thus smoothened, the Strike is made ready by tacking (that is by slightly nailing) on 2 Pieces of an old Felt-Hat on the Notches (or else by slipping a Case of Leather at each End) in order to raise the under Side of the Strike about $\frac{1}{8}$ of an Inch, or something more above the Sand, according as they would have the Sheets to be in thickness, which will make a middle-siz'd Sheet of about 9 or 10 Pound *per Foot*.

But for Hips and Window Soils, and such Places where it does not lie flat, the Lead need not be above $\frac{1}{10}$ of an Inch thick; but sometimes Plat-

Form Lead is near $\frac{1}{2}$ of an Inch thick.

Then they tallow the under Edge of the Strike, and lay it cross the Mould close by the *Pan*, to prevent the Drops of Lead from spattering into the Mould before it be ready to pour.

When the Lead is melted (and the Pan made ready by being lin'd with moistened Sand) it is lav'd into the Pan, in which when there is a sufficient Quantity for the present Purpose, they draw off the floating Part with a Piece of Board 2 or 3 Inches broad, or scum off the Mettle round about to the Edge of the Pan, and let it settle upon the Sand, which will by that Means prevent the Sand from falling out of the Pan into the Mould at the pouring out the Metal.

When the Metal has been thus prepar'd and cool enough (which is known by its beginning to stand with a Shell or Wall round about on the Sand) then 2 Men taking the Pan by the Handle, pour it into the Mould, while a third Man stands (facing them and his right Side to the Mould) ready with the Strike, as soon as they have done pouring in the Metal to put it on the Mould, and so draws off the Overplus of the Lead into the Hollows made to receive it, and then they immediately cut off with a Knife the ragged End, before it is cold.

When the Sheet is grown a little cool, they begin to roll it up from the upper End downwards

taken off, naturally inclines to return to its former State.

For a Proof of this they refer you to *Greenwich* Hospital, which was covered with mill'd Lead, which after it had been done not above 4 or 5 Years, rain'd in almost all over the Hospital; upon which Account the Master and Wardens of the Plumbers Company were sent for to the Parliament, who ordered them to go and view this mill'd Lead Work at *Greenwich* Hospital, which they did, and at their Return to the Parliament, they all unanimously declar'd, that mill'd Lead was not fit to be us'd: Whereupon the Parliament had Thoughts of putting down the milling of Lead.

Pipes of Lead.] Some Plumbers give distinct Names to their Leaden Pipes, according to their Weight at a Yard long, e. g. they have 6 l. 8 l. 10 l. 12 l. 14 l. and 20 and 28 l. Pipes, so that a Pipe of 6 l. to the Yard, they call a 6 l. Pipe

Lead for Glazing.] Some Glaziers say, that they usually allow 50 Pound of turn'd Lead to 100 Foot of Quarry Glass: They call it *turn'd Lead*, when the *Came* has pass'd thro' the Vice, and is thereby made with a Groove on each Side, to go on upon the Glass.

The *turn'd Lead* for Quarries is usually about $\frac{3}{8}$ (which is almost $\frac{1}{2}$) of an Inch Broad; and for large square Glass, their *turn'd Lead* is $\frac{8}{16}$ or $\frac{1}{2}$ an Inch broad, and they have it of these different Sizes $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$, $\frac{1}{64}$ and $\frac{1}{128}$ of an Inch broad.

The largest Size is for the large Squares, that of $\frac{1}{8}$ for Quarters, and the $\frac{1}{16}$ for croch Work (or Fret Work as it is called by some Glaziers) it being more pliable for that Use than broader Lead.

Glaziers can turn Lead of different Sizes in the same Vice, by changing their Checks for each Size, with another Pair of Spindles, whose Nuts almost meet or touch; they turn Lead for Tyers, which when it comes out of the Vice, is almost cut asunder in two Thicknesses, which they can easily rend asunder.

These *Tyers* are very tough; but they are commonly made too slight, and therefore, some cast *Tyers* which are stouter, but not so tough, being more apt to Break in winding.

Of Soldering.] As to the Method of *Paleing* (as they call it) or Soldering on of imboss Figures on leaden Work; as suppose, a Face or Head with a Bass Relief were to be paled on a Cistern of a Pump for an Ornament to it.

To perform this, the Plate where it is to be pal'd on, is first scraped very clean, and also the Back-side of the Figure, that it may fit close with a good Joint.

Then they place that Part of the Cistern (on which the Figure is to be fixed) horizontally, and strew some powdered Rosin on the Place where the Joint is made, then a Chafing-Dish of Coals being set into the Cistern just under the Place where the Figure is to stand

stand, 'till the Rosin is chang'd reddish, and begins to rise in Pimples or Bladders, they take a Piece of soft Solder (made of a longish Figure) and rub the End of it round their Finger, keeping at the same Time their Finger steady in the Place, so that it may work in to the Joint. And when this is done, the Figure will be well pal'd on, and will be as firm as if it had been cast on there.

But if the Cistern, &c. be so thin, as that there may be Reason to fear that it will be too hot, and apt to run or bend, and yield before the Figure (which is on the out-side of it) will be hot enough; you may then lay your Figure on the hot Coals, 'till it, and the place to receive it, are both in a good Temper for *Paling*, and then set the figure on its Place, and proceed to foldering of it as before.

In Soldering the Leads of Churches, they sometimes manage it as follows, *viz.* When they folder the Sheets of Lead, which are fixed into the Wall on one Edge, and with the other Edge lap over the Ends of those which are seam'd in the Platform, at every other Sheet, in the middle betwixt the Seams, they Solder the lapping Sheets down to the other thus-----: With one corner of the Scraper [which is an Instrument made of a Plate of Steel in the form of an equilateral Triangle, in the Middle of which is fixed an Iron Strig, on the End of which is fix'd a wooden Knob, or Handle;

the Plate is flat on the Side next the Handle, but on the other Side the Edges are ground off with a Bezel like a Chizel, only very obtuse.]

They first mark out (partly on the Edge of the Lapping Sheet and partly on the other) an oblong rectangular Figure, of about 5 or 6 Inches long, and 3 or 4 broad, then they scrape the Metal bright, having first (because it was new Lead) green'd it (as they phrase it) all round about; to prevent the Solder's taking any where but where it has been scrap'd.

This *Greening* is only rubbing it with some green Vegetable, it matters not what, as Cabbage-Leaves, or any green Thing they can get.

After it has been scraped, they rub it with Tallow, and having a red hot Iron ready, they take a Piece of Felt in the Right Hand, and a Piece of Solder in the Left, and holding it against the Iron 'till it drops on the cleansed Place, and when there is enough of it melted they take a Linnen Clout in the Left Hand, and with it keep the Solder continually shoved upon the cleansed Place, and at the same Time work it about with the Iron in the Right Hand, 'till it is pretty well incorporated with the Lead, and so make it up into a kind of swelling Form in Breadth, and then cross the Breadth of it making it into a kind of Seams with the Point of the Iron.

When this is done, they take Knife and Dresser to knock it with,

with, and so cut it strait on the Sides and Ends, and what was thus cut off by reason of the *Greening* easily peeled off.

The Price of Lead in Pigs, says Mr. *Leybourn* is uncertain, as from 10 to 20 s. the Hundred Weight. Sometimes it is 10, sometime 12 s. sometimes 14 s. *per* Hundred Weight. &c.

Mr. *Wing* says, a Fodder of Lead is $22 \frac{1}{2}$ C. Weight, but most Authors say, but $19 \frac{1}{2}$ C. Weight, which is worth from 9 to 12 l. which will cast 315 Foot of Sheet, at 8 l. *per* Foot.

The Price of Sheet Lead.] Mr. *Leybourn* says that in Exchange of Old Lead for Sheets new run, there is commonly allowed 3 s. in every Hundred Weight for Waste and Workmanship.

The Price of casting Sheet Lead, is commonly about 4 s. *per* Hundred, for casting Old Lead into Sheets; but if so, probably the Plumber (for this Price) makes good so many Hundred Weight of Sheet Lead as he received of Old Lead; since Mr. *Leybourn* says it is done for 3 s. *per* Hundred.

Mr. *Wing* says, that there is about 2 s. 6 d. (in every Hundred) loss in casting Old Lead into Sheets. He also says, That casting Old Lead into Sheets is worth 1 s. 6 d. *per* Hundred.

The Price of laying on Sheet Lead in Roofing, &c.] This, Mr. *Wing* says, is worth 15 or 16 s. *per* Hundred Weight,

Lead and Workmanship. And Mr. *Leybourn* says, that, Covering with Lead is usually valued at 13, 14, or 15 s. *per* Yard Square (according to the Goodness of the Lead) or between 7 and 8 Pound the Square of 10 Feet, besides Solder.

The Price of Solder] This, Mr. *Leybourn* says, is 9 d. or 10 d. *per* Pound, as it is allay'd with Lead and scalled: For Tin is 10 d. 11 d. or 12 d. *per* pound neat.

The Price of Leaden Pipes. This is Various according to their different Bigness.

Some say, that for Pipes of half an Inch Diameter in the Bore, they have 1 s. 4 d. *per* Yard, $\frac{3}{4}$ of an Inch Pipe, 1 s. 10 d. for Inch Pipe, and $1 \frac{1}{4}$ Inch Pipe, 2 s. or 2 s. 6 d. (these last being said to be cast both in a Mould, only the Inch Pipe has a less Bore). For Pipes of an Inch $\frac{1}{2}$ bore, 3 s. 6 d. *per* Yard, and for 3 Inch Pipes, 5 s. or 5 s. 6 d. *per* Yard. *London* Plumbers rate their Pipes according to the Weight of a Yard in Length, their 10 Pound Pipes are 2 s. 2 d. *per* Yard.

The Price of turn'd Lead for Glazing is also various, according to its Breadth; that of $\frac{7}{8}$ broad has been sold for 18 s. *per* Hundred, that of $1 \frac{1}{8}$ broad for 17 s.

RED LEAD is the lightest of all Reds now in Use; it is a Sandy, harsh Colour, and will not easily grind very fine, altho much Labour be bestow'd on it.

This Colour is made out of common

Common Lead; having been first reduced to a Litharge, and afterwards ground to Powder in a Mill, 'tis then put into a hot Furnace, made for that Purpose, where it is continually kept stirring with an Iron Rake, 'till it has attain'd a fine Pale-Red Colour; the whole Process of making it may be seen in Mr. Ray's Appendix to his Catalogue of hard *English Words*.

Note, That though this is a Sandy Colour, yet it bears a very good Body in Oil, and binds very fast and firm, being also a quick Dryer.

WHITE LEAD is the Principal of all *Whites*, and owes its Original to the Common Lead used by Plumbers, of which it is made.

The manner of making it at *Venice*, where the greatest Quantities of it are made, is as follows.

They take Sheet Lead, and having cut it into long and narrow Slips, they make it up into Rolls; but so that a small Distance may remain between every spiral Revolution: These Rolls are put into Earthen Pots, so order'd that the Lead may not sink down above half Way, or some small matter more in them; these Pots have each of them very sharp Vinegar in the Bottom, so full as almost to touch the Lead. When the Vinegar and Lead have both been put into the Pot, it is cover'd up close, and so left for a certain Time, in which Space the corrosive Fumes of the Vinegar will reduce the Superficies of the Lead into a

white Calx, which they separate by knocking it with a Hammer.

There are two Sorts of this sold at the Colour Shops, the one call'd *Ceruse*, which is the most pure and clean Part, and the other is call'd by the plain Name of *White Lead*.

These Colours work with very much Ease, and will be ground as fine as even the Oil itself, in Comparison, if Time and Pains enough be taken in the grinding of it: It lies very smooth, and binds very hard, on what Work soever it be laid on.

If any Kind of Timber or Stone Work be painted with it, to preserve it from the Weather, it is best to work it in Linseed-Oil, for that will bind it extreme hard, if it be laid stiff upon the Work; but if *White Lead* be us'd alone within Doors, it will then be best to mix it with drying Nut Oil; for Linseed Oil, within Doors, will turn yellow, and spoil the Beauty of it; which Inconvenience Walnut Oil made to dry, prevents, for that makes it keep a constant whiteness.

LEDGERS, See *Putlogs*.

LEMMA [in *Geometry*] is a Term us'd chiefly by Mathematicians, and signifies a Proposition, which serves previously to prepare the Way for the more easy Apprehension of a Demonstration of some Theorem, or for the Construction of some Problem.

LENS [in *Opticks* and *Dioptricks*] is any Glass that is not very thick, which either
C collects

collects the Rays of Light into a Point, in their Passage thro' it, or disperses them farther apart, according to the Laws of Refraction.

Lenses have various Figures; that is, they are terminated by various Circumstances, from whence they acquire various Names.

Some are Plane on one Side, and Convex on the other; others Convex on both Sides, which are both usually rank'd among the Convex *Lenses*, tho' in accurate Speaking, the former is call'd *Plano Convex*.

Some are Plane on one Side, and Concave on the other, and others are Concave on both Sides, which are usually call'd *Concave Lens*, tho' when distinguish'd, the former is call'd a *Plano Concave*.

Others are Concave on both Sides; others are Concave on one Side, and Convex on the other; which are call'd *Convexo Concave*, or *Concavo Convex Lenses*, according as the one or other Surface is more Curve, or a Portion of a lesser Sphere.

LEVEL, A Mathematical Instrument, serving to draw a Line parallel to the Horizon; to lay off Floors, the Courses of Masonry, &c. Horizontally, to measure the Difference of the Ascent or Descent between several Places, to convey Waters, drain Fens, &c.

Carpenters LEVEL consists of a long Ruler, in the middle whereof is fitted at Right Angles, another somewhat bigger, at the Top of which is

fastened a Line; which when it hangs over a fiducial Line at Right Angles with the Base, shews that the said Base is horizontal.

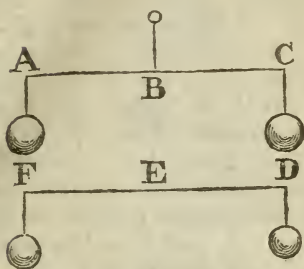
Masons LEVEL, is compos'd of 3 Rules, so join'd as to form an Isosceles Rectangle, somewhat like a Roman A; at the Vertex whereof is fastened a Thread, from which hangs a Plummet; which passes over a fiducial Line, marked in the middle of the Base, when the Thing to which the *Level* is apply'd, is horizontal; but declines from the Mark when the Thing is lower on one Side than the other.

LEVELLING, is the Art of finding a true Horizontal Line; or the Difference of Ascent or Descent between any 2 Places, or to determine the Height of one Place with Respect to another, for the laying of Grounds even, regulating of Descents, draining Morasses, conducting of Waters, &c.

The **LEVER** is no other than the *Ballance*, excepting the Manner of its Application in Practice.

LEVER [in *Mechanicks*] an inflexible Right Line, supported by a single Point on a *Fulcrum* or Prop, and us'd for the raising of Weights; being either void of Weight it self, or at least having such a Weight as may be balanc'd. The Lever is the first of those call'd *Mechanical Powers*; or *Simple Machines*, being of all others the most Simple, and is chiefly apply'd for raising of Weights to small Heights; that

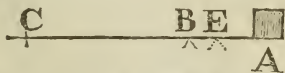
is, as the Ballance is suspended or hung on the fixed Point or



Centre of Motion, as A C on B, the *Lever* rests upon a Point as D F on E, which is also call'd either the fix'd Point, *Centre of Motion*, *Fulcrum* or *Fulcrimen*.

There are 4 Kinds of *Levers* in Use, call'd a *Lever* of the first Kind, a second Kind, a third Kind, and a fourth Kind.

A *Lever* of the first Kind is that whose *Fulcrum* is between the Power apply'd, and the Weight that is to be rais'd, as



A C, where the Power is apply'd at C, the Weight A, and the *Fulcrum* between them, as at B.

The Weight which may be rais'd by this *Lever* with a given or known Power or Strength apply'd at C, may be known by the following Canon or Analogy :

As the lesser Brachia A B, being always contain'd between the middle of the *Lever*, and the Weight to be rais'd, is to the greater Brachia B C,

So is the Power apply'd at C, to the Weight that it will raise at A.

Suppose the *Lever* A C to be 12 Foot long, and the Power apply'd, = 10 Pound Avoirdupoise, and let the *Fulcrum* B be at 9 Foot Distance from C.

Then I say,

As 3 the lesser Brachia,
Is to 9 the greater Brachia,
So is 10 the Power apply'd at C, to 30 the Weight that C will raise at A.

The Operation.

$$\begin{array}{r} 3 \quad 9 \quad 10 \quad 30 \\ \quad \quad 9 \\ \hline 3) 90 (30 \end{array}$$

And here observe, that the nearer the *Fulcrum* is plac'd to the Weight, the greater Weight can be rais'd,

As for Example,

Suppose the *Fulcrum* be plac'd at 10 Feet Distance from C at E, then I say,

As A E 2, the lesser Brachia, is to E C 10 the greater Brachia,

So is 10 the Power, apply'd at C to 50, the Weight that C will raise at A.

The Operation.

$$\begin{array}{r} 2 \quad 10 \quad 10 \quad 50 \\ \quad \quad 10 \\ \hline 2) 100 (50 \end{array}$$

Now 'tis plain, that by moving the *Fulcrum* one Foot nearer towards the Weight, the Power is increas'd from 30 to 50, and therefore to Equipoise the Weight A on the *Fulcrum* E, then is but 6 Pounds requir'd, as a Power at C. For :

As $E C$ 10 Feet the greater Brachia, is to $A E$ 2 Feet.

So is 30 the Weight A , to 6 the Power requir'd at C , to equipoise A .

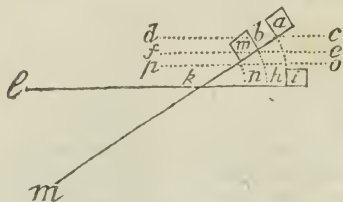
The Operation.

$$\begin{array}{r} 10 \quad 2 \quad 30 \quad 6 \\ \quad \quad 2 \\ \hline 10) 60 (6 \end{array}$$

Hence it is evident that the nearer the *Fulcrum* is to the Body or Weight, the lesser Power it requires to equipoise the same, and consequently the lesser to raise the same; or otherwise the farther the Power is distant from the *Fulcrum*, the more Force it will proportionably have.

But here it is to be observ'd, that when by moving the *Fulcrum* near to the Weight by which the Power is increas'd, that at the same Time the Space or utmost Height of raising the Weight is diminished accordingly.

Let $I L$ be Lever 12 Foot long, with its *Fulcrum* k , at 9



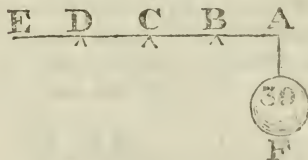
Feet from l ; then if the Point l be depress'd to m , it will raise the Body i unto l , on the horizontal Line $c d$.

But if the Weight or Body i be mov'd nearer to k as at b , whereby a lesser Power will raise it, than when the End of the Lever l is depress'd, as before to m , the Body b will be rais'd no higher than b on the horizontal Line $e f$.

And again, had the Body i been plac'd at n , it could not be rais'd higher than m , on the Line $o p$, and so in like Manner of all others, Q.E.D.

Hence 'tis plain, that the higher the Body is rais'd, the greater Distance it must be from the *Fulcrum*, and consequently the greater Strength or Power is requir'd to raise the same.

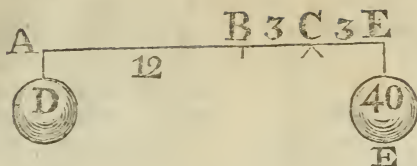
Whence it is evident, that as the Distance of the Weight from the *Fulcrum*, may be greater as $B C$, than the Distance



of the Power $A B$, or lesser (as $A B$) than the Power $B C$, or equal to one another, as $A B$, and $B C$ in the Ballance, Figure 9; so proportionably must the Powers be apply'd.

Suppose that $A E$ is a Lever 12 Foot long, that the *Fulcrum* be fix'd at C , 3 Feet from E , the Place where the Power is to be apply'd, and that the Body F hanging at E , weigh 30 Pounds; what Power at A will equipoise E , and by what Analogy is it to be found?

Answer.



Answer. The Analogy is as follows.

As C E 3, the lesser Brachia, is to C A 9, the greater Brachia,

So is 40 the Weight E, to 90 the Power required at E, to equipoise the Body F at A.

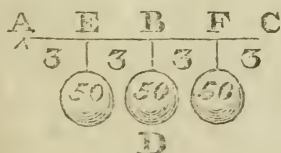
Operation.

$$\begin{array}{r} 3 \quad 9 \quad 40 \quad 120 \\ \quad \quad 9 \\ \hline 3)360(120 \end{array}$$

Hence 'tis plain, that this Analogy is the same as the first Analogy of the Lever of the first Kind; for if you suppose that the Body E be a Power given, then the Power requir'd to equipoise the same, is no more than to find the Weight or Power that the given Weight will equipoise.

This may suffice as to the Lever of the first Kind.

A LEVER of the Second Kind, is one wherein the first Point or *Fulcrum* is plac'd at



one End (as at A) the Power apply'd at the other End (as at C) and the Weight suspended between them, as at E B F, &c.

The following Canon or

Analogy, will give the Weight that any given Power will raise, or what Power is requir'd to raise a given Weight; that is to say,

As the Distance of the Weight from the *Fulcrum*,

Is to the Distance of the Power from the *Fulcrum*,

So is the Power of the Weight that will equipoise it. And here note, that when the equipoise of any Weight is found, a very small Addition thereto is the Power that will raise it.

Let the Power at C be = 10 Pounds Averdupoise, and the Lever A C be = 12 Feet in Length, and let the Body D be hung in the Middle at B, 6 Feet Distant from the Power C, as well as from the *Fulcrum* A. Then I say,

As B C, 6 Feet Distance of the Weight from the Power, is to A B 12 Feet, the Distance of the Power from the *Fulcrum*, so is 10 Pounds the Power at C to 20 Pounds in *Æquilibrio*.

Again.

Let the Body D be mov'd to E, at 3 Feet Distance from the *Fulcrum* A. Then I say,

As A E 3, the Distance of the Weight from the *Fulcrum*,

Is to A C 12, the Distance of the Power from the *Fulcrum*,

So is 10 the Power apply'd at C, to 40 its *Æquilibrio*.

C 3

The

The Operation.

As 3 : 12 : 10 : 40

12

3) 120 (40

Again.

Let the Body or Weight D be mov'd to F, at 9 Feet Distance from the *Fulcrum* A;

Then I say,

As A F, 9 Feet the Distance of the Weight from the *Fulcrum*, Is to A C, the 12 Feet, the Distance of the Power from the *Fulcrum*,

So is 10 the Power apply'd at C to 13 and a half its *Equilibrium*.

The Operation.

9 : 12 : 10 : 13 + 3 qurs.

12

9) 120 (13 3 qurs.

Hence it is also evident, as in the *Lever* of the first Kind, that the nearer the Weight is to the *Fulcrum*, the greater is the Power increas'd.

For in this last Example, where the Weight was apply'd at F, 9 Feet Distance from the *Fulcrum* A, the Power C 10 would equipoise but 10 Pounds 3 Quarters; but where the Weight was apply'd nearer to the *Fulcrum*, as at B, 6 Feet from the *Fulcrum* A; then its equipoise was equal to 20 Pounds.

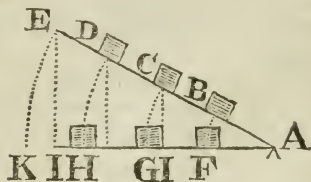
And again, when the Weight was apply'd still nearer to the *Fulcrum*, as at E, then the equipoise at C was = 40 Pounds, Q E D.

And as has been already prov'd in the *Lever* of the first Kind, that what is gain'd

in Power, is lost in Space or Time; so also 'tis the same in this Kind of *Lever*.

For Example.

Suppose the Power at K, is to be rais'd from K to E, = 6 Feet above I, and at the same Time was to raise the Weight



G, plac'd in the middle of it; Then I say, that though the Weight equipois'd at C, is double to the Power E, yet G is rais'd but half the Height of E, above I; that is, as the equipoise G, rais'd to C, is double the Weight of the Power K, rais'd to E.

So is the Space or Arch E K through which the Power K pass'd in going to E, double or = twice the Space or Arch G C, through which the Body or Weight G pass'd in going to C, and so in like Proportion of all others, according to their Distance from the *Fulcrum*.

Now to find a Power equal to a given Weight, having the *Fulcrum* assign'd, and the Length of the *Lever* given.

This is the Analogy.

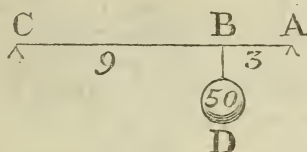
As the Distance of the Power from the *Fulcrum*,

Is to the Distance of the Weight from the *Fulcrum*, so is the given Weight to the Power requir'd to equipoise the same.

Let

Let the given Weight D, be = 50 Pound, plac'd at E, 3 Feet distant from the *Fulcrum* A, and let the Power be apply'd at C, 12 Feet distant from the *Fulcrum* A, then I say,

As 12 the Distance of the Power from the *Fulcrum*, is to A E 3, the Distance of the Weight from the *Fulcrum*, so is 50 the given Weight of the Body D to 12 and half the Power requir'd at C, to equipoise D.



Operation

$$\begin{array}{r}
 \text{As } 12 \quad 3 \quad 50 \\
 \quad \quad \quad 3 \\
 \hline
 12) 150 (12\frac{1}{2} \\
 \quad 12 \\
 \hline
 \quad \quad 30 \\
 \quad \quad \quad 24 \\
 \quad \quad \quad \quad 6 \\
 \hline
 \quad \quad \quad 6 \quad 12\frac{1}{2}
 \end{array}$$

Question. When with a Lever of the Second, raises a Body of 50 Pound Weight, with a Power = to 25 Pound, what sustains the other 25 Pounds?

Answer. The *Fulcrum* on which it rests. For Proof,

Suppose that A and B were 2 Powers, sustaining the Weight B at D, 3 Foot from A. As the Weight D is nearer to the Power at A, than to the Power

at E, therefore the Power at A, sustains the greater Part of the Weight.

Demonstration.

I suppose A to be the only Power, and C the *Fulcrum* and let the Lever A C be = 12 Feet.

Then I say as before,

As A C 12, the Distance of Power A from the *Fulcrum* C,

Is to B C 9, the Distance of the Weight D from C.

So is D 50, the given Weight to 37 and a half, the Power requir'd at A to equipoise B.

Operation.

$$\begin{array}{r}
 12 \quad 9 \quad 50 \quad 37\frac{1}{2} \\
 \quad \quad \quad 9 \\
 \hline
 12) 450 (37\frac{1}{2} \\
 \quad \quad 36 \\
 \hline
 \quad \quad \quad 90 \\
 \quad \quad \quad \quad 84 \\
 \hline
 \quad \quad \quad \quad \quad 6 = \frac{1}{2}
 \end{array}$$

Hence 'tis evident, that the Power A sustains 37 and half Pounds of the Weight B, which is = 50 Pounds.

Again.

Suppose A to be the *Fulcrum*, and C the Power with the Weight as before.

Then I say.

As C A 12 the Distance of the Power C from the *Fulcrum* A,

Is to A B 3, the Distance of the Weight from the *Fulcrum*.

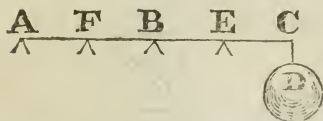
So is D 50, the given Weight to 12 and a half the Power requir'd to equipoise D.

The Operation.

$$\begin{array}{r}
 12 \quad 3 \quad 50 \quad 12\frac{1}{2} \\
 \quad \quad \quad 3 \\
 \quad \quad \quad \hline
 12) 150 \quad (12\frac{1}{2} \\
 \quad \quad 12 \\
 \quad \quad \hline
 \quad \quad 30 \\
 \quad \quad 24 \\
 \quad \quad \hline
 \quad \quad 6 = \frac{1}{2}
 \end{array}$$

Hence 'tis evident, that the Power C sustains but $12\frac{1}{2}$ Pounds. Now if to $37\frac{1}{2}$ be added $12\frac{1}{2}$, the Sum is $= 50$, the given Weight sustain'd by A and C. Q E D.

The LEVER of the third Kind hath its fix'd Point or



Fulcrum, at the other End, as D at G, and the Power apply'd at any Part between them, as E B F, &c.

Now seeing that the Power apply'd must be always between the 2 Ends; therefore it follows, that the Power must always exceed the Weight to be rais'd, or otherwise no Weight can be rais'd thereby.

Suppose the Lever $AC = 12$ Foot, A the *Fulcrum*, and at C is plac'd the Weight $D = 50$ Pounds. I say, that if the Power be apply'd in the middle at B, it must be $= 100$ Pounds Weight to equipoise D.

For the *Fulcrum* being fix'd at A, it makes a Resistance equal to the Weight D, or rather a greater; or otherwise

the Power at B could not raise it. Therefore

As A B 6, the Distance of the Power from the *Fulcrum*,

Is to A C, 12 the Distance of the Weight from the *Fulcrum*,

So is 50 the given Weight D, to 100, the Power requir'd at B, to equipoise D at C.

Secondly. Suppose the Power to be apply'd at E, 3 Feet from the *Fulcrum* A;

Then I say,

As 3 Feet, the Distance of the Power from the *Fulcrum*,

Is to 12 Feet, the Distance of the Weight from the *Fulcrum*,

So is 50 the given Weight to 200, the Power requir'd at E, to equipoise D at C.

Again.

Suppose the Power to be apply'd at E, 9 Feet from the *Fulcrum* A;

Then I say,

As 9 Feet the Distance of the Power from the *Fulcrum*,

Is to 12 Feet the Distance of the Weight from the *Fulcrum*,

So is 50 the given Weight to 66 $\frac{2}{3}$ qrs, the Power requir'd at E, to equipoise D at C.

Now from these Examples 'tis also evident, that the farther the Power is apply'd from the *Fulcrum*, the lesser the Power is requir'd, tho' always greater than the Weight rais'd.

But however, tho' this Kind of Lever doth lose in its Power, contrary to both the others, yet it does not lose in Time or Space also, as they do; but on the contrary, it gains in Space or Time proportionably.

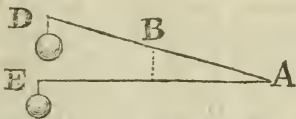
As for Example.

Let A E be a Lever $= 12$ Foot

Foot, A the *Fulcrum*, E the *Weight*; and the Power apply'd in the middle at C.

Then I say, if the Power C raises the Lever A E, with the Weight E into the Position A B D, then will E have pass'd the Arch E D, which is equal to twice the Arch B C, through which the Power C hath mov'd.

For since that A C is = A E; Therefore as A H is to H B, so is twice A h (that is A h + b g) to g D, which is =



to twice B h the Triangle A B h, and A D g being similar, Q E D.

This Kind of Lever is chiefly us'd in the Regulators of Water Engines, where it is required to strike a greater Stroke, than that of the Crank, as at *London Bridge*, where the Power of the Crank Rods are apply'd between the forcing Rods and the *Fulcrum* of the Regulator.

This Lever is also shewn by the raising of a Ladder, when the Power is apply'd in the middle; the End resting, or kept down on the Ground, as its *Fulcrum*, and the Weight beyond the Power, is the Weight requir'd to be rais'd.

Q. But suppose a Power is given with its Distance from the *Fulcrum*, as also the Length of the Lever, how is that Weight to be found, which the given Power can equipoise?

A. This is found by the following Canon or Analogy.

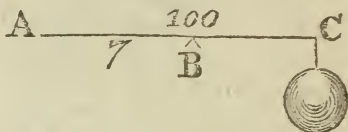
Suppose the given Power to be 100 Pounds, apply'd at 7 Feet Distance from the *Fulcrum*, and that the Length of the Lever is = 12 Foot.

Analogy.

As the Distance of the Weight from the *Fulcrum*,

Is to the Distance of the Power from the *Fulcrum*,

So is the Power apply'd to the Weight it will equipoise.



Then I say,

As 12 the Distance of the Weight from the *Fulcrum*, is to 7, the Distance of the Power from the *Fulcrum*,

So is 100 the Power apply'd at B, to 58 3 qrs. the Weight at C, which it can equipoise.

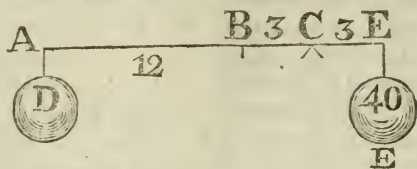
The Operation.

$$\begin{array}{r}
 12 \quad 7 \quad 100 \\
 \quad \quad 7 \\
 \hline
 12) 700 (58, 3 \text{ qrs.} \\
 \underline{60} \\
 100 \\
 \underline{96} \\
 4 = 1 \text{ qr.}
 \end{array}$$

If a Lever of the third Kind, as C A, be continued beyond the *Fulcrum* = to the Distance of the Power apply'd (supposing B, the Power given) that is

is making $E C =$ to $C B$, then it will become a Lever of the first Kind, and the same Power which was apply'd at B, as a Lever of the third Kind, being

apply'd at E, as a Lever of the first Kind, will have the same Effect in equipoising the Body D, as when at B.



Suppose $C A = 12$ Feet, $C B = 3$ Feet, and let the Weight D sustain'd at A be equal to 10 Pound: Then I say, that if A C be continued to E, making $E C = C B 3$ Feet, then the same Power requir'd to equipoise D at B, being apply'd at E, will equipoise D also.

Demonstration.

First, considering E A as a Lever of the first Kind, whose *Fulcrum* is C, and let the Weight D be $= 10$ Pounds.

Then I say,

As $E C 3$, is to $C A 12 ::$ So is D 10, to E 40, which is the equipoise of D, apply'd at E.

Again.

Considering C A as a Lever of the third Kind, with the Power apply'd at B, 3 Feet from the *Fulcrum* C.

As $C A 12$ is to $C B 3 ::$ So is 40 apply'd at B to 10 its Equipoise at A.

Or as $C B 3$, is to $C A 12 ::$ so is 10 the Weight at A, to 40 the Power apply'd at B. Hence it is plain, that the same Power has the same Effect, either at E or B. Q E D.

These are the only distinct Kinds of Levers that are yet known; the fourth Lever being no more than the Lever of the first Kind, bended or making an Angle at its *Fulcrum*; as the Handle of a Hammer, considered with its Head and Claws, when us'd in drawing a Nail, for then its Head is the *Fulcrum*, and it being between the Claws that lay hold of the Nails and that Part of the Handle, where the Hand or Power is apply'd to draw the Nail, does therefore become a real Lever of the first Kind.

And tho' 'tis call'd a Lever of the fourth Kind, or the bended Lever, yet it is no more than a Lever of the first Kind, and the Analogies thereof are the same in all Respects.

N. B. That in the Practice of all these Operations, there has been no Allowance made for the real Weights of the Levers themselves, as has been noted; but therefore it must always be remembred in Practice, to make an Allowance for their own Weights, exclusive of the Powers apply'd.

LIGHTS [in Architecture.]

Are understood of the openings of Doors Gates and Windows, and other Places through which the Air and Light have Passage.

LIME, calcin'd Stone, Marble, Free-Stone, Chalk, or other Matter, burnt in a large Fire in a Kiln or Furnace built for that Purpose; to be afterwards used in the Composition of Mortar for Building, the Fire taking away all its Humidity, and opening its Pores, so that it becomes easily reducible to Powder.

Mr. *Leybourn* tells us out of *Palladio*, That Stones, whereof Lime is made, are either dug out of Hills, or taken out of Rivers: That Lime is best, that is made out of the hardest, sound, and white Stones, and being burnt, remains a third Part Lighter than the Stones whereof it is made.

All dug Stones are better to make Lime of than gathered Stones; and from a shady and moist Pit, than from a dry.

All Stones are sooner or later Burnt, according to the Fire which is given them; but they are ordinarily burnt in Sixty Hours.

Sir *Henry Wootton* looks upon it as a great Error in the *English*, to make Lime as they do, of Refuse and Stuff without any Choice, whereas the *Italians* at this very Day, and much more the Ancients, burnt their Firmest Stones, and even Fragments of Marble, where it was Plentiful, which in Time became almost Marble again, for its Hardness, as appears in their Standing Theatres, &c.

There are two Kinds of Lime in Common Use in *England*, the One made of Stone, and the other of Chalk, whereof the former is much the Strongest.

That which is made of soft Stone or Chalk, is the fittest for Plaistering of Ceilings, and Walls within Doors; and that made of hard Stone, is fit for Structures or Buildings, and Plaistering without Doors, that lie in the Weather.

And that which is made of a greasy, clammy Stone, is stronger than that made of a poor lean Stone; and that which is made of a spongy Stone, is lighter than that made of a firm and close Stone; that is again more Commodious for Plaistering, this for Building.

Good Lime may also be made of Mil-Stone, but not coarse and sandy, but fine and greasy: as likewise of all Kinds of Flints; tho' 'tis hard to burn them, except in a Reverberatory Furnace as being apt to run to Glass, unless those that are roll'd in Water, because the greatest Part of its Increase goes away by a Kind of Glass.

Dieussant recommends Lime made of Sea Shells, as Cockle, Oysters, &c. as the best; but *Goldman* findes Fault with it, as being impatient of Moisture, and therefore easily peeling off from the out-side Walls: However, it is the Common Lime used in the *Indies*.

About *Sussex*, Lime is made of hard Chalk digged out of the Hills, and is burnt in Kilns
like

like Brick-Kilns, but with this Difference, that they have no Arches in them; but only a kind of Bench or Bank, on each Side, upon which they lay the largest Stones, and so truss them over and make an Arch, after the Manner of Clamps for Bricks, and when they have thus made an Arch with the largest Stones, they fill up the Kiln with the smaller ones.

Some have said that *Kentish Lime* is far better than that commonly made in *Sussex*; because they say, a Gallon of Water will make as much more *Kentish Lime* run, as it will of *Sussex Lime*; so that it should seem (by the Consequence) that, that is the best *Lime* which will run with the least Moisture.

Before the Stones are thrown into the Kiln, they are to be broken to Pieces; otherwise the Air contained in their Cavities, too much expanded by Heat, makes them fly with so much Violence as to damage the Kilns.

Alberti and *Palladio* say, that Lime will not be sufficiently burnt in less than Sixty Hours; and *Alberti* gives the Marks of a well burnt Lime to be as follows, *viz.* that its Weight is to that of the Stone in a sesquialterate Proportion; that it is white, light and sonorous; that when flaked, it sticks to the Sides of the Vessel. To which *Boeckler* adds, that when flaked, it sends forth a copious thick Smoak; and *Dieussant*, that it requires a great deal of Water to flake it.

Walter Burrel of *Cuckfield* in *Sussex*, Esq; was the First that introduc'd the Use of *Fern*, for burning of Lime, which serves that Purpose as well as Wood, (the Flame thereof being very vehement) and is far cheaper.

In order to preserve Lime several Years, flake and work it up; dig a Pit under Ground, into which let it pass through a Hole open at the Bottom of the Vessel: As soon as the Pit is full, cover it up with Sand, to prevent its drying; thus keeping it moist 'till it be used.

Boeckler gives another Method. Cover a Stratum or Layer of Lime Two or Three Foot high with another of Sand of the like height; pour on Water enough to flake the Lime, but not to reduce it to Dust after flaking. If the Sand cleave into clush as the Smoak ascends, cover them up, so as no Vent may be given thereto.

He says, that this Lime, being kept 10 or 12 Years, will be like Glue, and will further be of particular use in painting Walls, as being no way prejudicial to the colours.

Quick LIME, or unslak'd Lime, is that which is as it comes out of the Furnace.

Slak'd LIME, is that wash'd or steep'd in Water, and reserv'd for the making of Mortar.

Lime is commonly sold about *London* by the Hundred, which is 25 Bushels, or 100 Pecks; but in the Country, by the Load, of 32 Bushels.

A Load of Lime, as some say,

say, will make Mortar enough for 250 solid foot of Stone-work; and 8 Bushels of Lime, heap'd Measure, is the common Allowance to every thousand of Bricks.

The Price.] The Price of Lime differs according to the Places, as from 8 to 12 s. the Hundred.

Before the late Wars, which have made Fuel scarce (says a certain Author) *Lime* in some Parts of *Suffex* has been sold for 20 or 21 s. per Load, 32 Bushels to the Load, but since, in some Parts of *Suffex*, it has been sold for 24 or 25 s. per Load, and in others for 32 s.

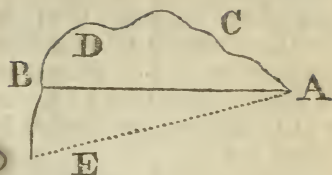
Yet in some Parts of *Suffex* it is still sold for 12 s. per Load at the Kiln, and for about 15 s. 6 d. laid in 3 or 4 Miles.

LIME-STONE, is a Stone of a whitish Colour, which being burnt in a Kiln, enters the Composition of Mortar, Plaster, &c.

LIMITED Problem, is one which has but one, or a determined Number of Solutions; as to make a Circle pass thro' 3 Points given, not lying in a right Line; to describe an equilateral Triangle on a Line given.

LINE, according to *Euclid*, is a Longitude without Latitude, or a Length without Breadth or Thickness.

A Line is generated by the

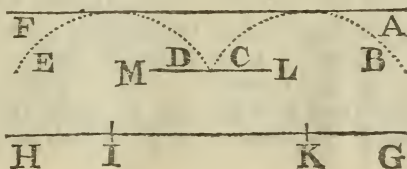


Motion of a Point from one Place to another. Thus the Point A moving directly from A to B, generates the right Line AB; therefore a right Line is the nearest distance between two Points, which are the Bounds or Limits of it.

But had the Point A in going to B first gone to C, and thence to D, and afterwards to B, it would by its irregular Motion have described a crooked Line, as A C D B; which being irregular without any Respect to a Centre, is therefore call'd an irregular curv'd Line.

If the right Line AB be fix'd at the Point A as a Centre, and afterwards the End B be moved to E, it will by its Motion generate or trace the crooked Line BE; and because that all the Parts of that crooked Line are at equal Distance from A, the Centre whereon it was describ'd is therefore called a Regular curved Line.

A **RIGHT LINE**, GH being given to draw the Right Line AF, parallel at the given Distance of the Line LM,



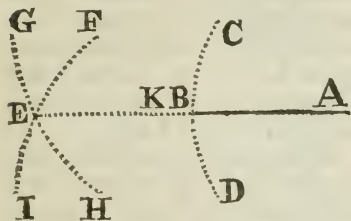
First,

First take the Length of your given Distance L M, in the Compasses, and with that Opening on any 2 Points, in the Ends of the Line G K, as at H I, describe the Arches B C, and D E.

2. Lay a Ruler to the Extremes of those Arches, and draw the Right Line A F, which will be parallel to G K, as requir'd.

The Right LINE A K of a certain Length being given to continue the said Line A longer to E.

1st. On A with a opening of your Compasses, describe an Arch, as C D; and from the

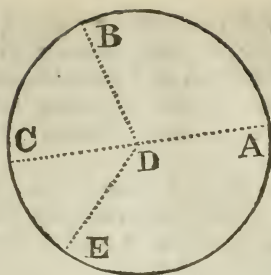


Point of Intersection, set off on the Arch any equal Distances to C and D.

2d. With any large Distances greater than D B, on the Points D and C describe Arches, as F I and G H, intersecting each other in E.

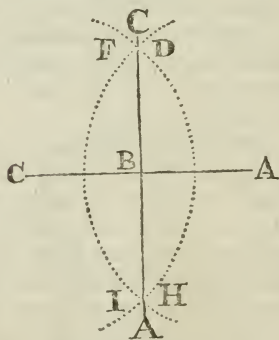
3d. From the Point B to the Point E, draw the Right Line B E the Continuation requir'd.

A Circular LINE is generated by the End of a Right Line. Suppose the Right Line A D, fix'd at its End D as a Centre, then if it be moved from A to B, and from B to C, its End A, will describe a



Curv'd or Circular Line A B C, which is also call'd an Arch of a Circle; for was the Point C to be mov'd on to E, and from thence to A, it would compleat a round Space A B C E A, which is called a Circle.

To divide a Right Line A C into two equal Parts by the perpendicular A C.

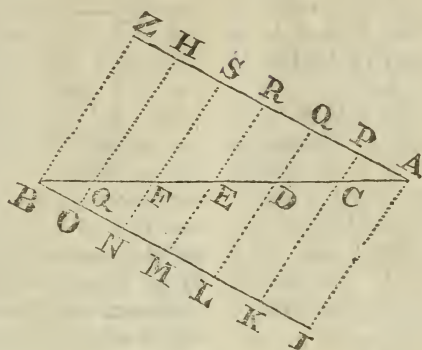


1st. Open the Compasses to any Distance greater than half the given Line A C, and at each End, as at A and C describe Arches, as D B and F I, intersecting each other in the Points C and A.

2dly. From the Points A and C, draw the Right Line A C, which is the Perpendicular

cular requir'd, which will divide A C into two equal Parts, at the Point B.

To divide the Right LINE A B into any Number of equal Parts, as suppose 6.



1st. From one End of the given Line A B, draw another Right Line, as A B from A, making any Angle at Pleasure; then from the other End, as B, draw the Right Line B I, parallel to it, or make the Angle A B I = to the Angle H A B.

2^{dly}. Open the Compasses to any Distance, suppose A P, and as the Line is to be divided into 6 Parts; therefore set off 5 of those Distances on the Line A Z, at the Points P Q R S H, as likewise the same on the Line B I, at the Points O N M L K.

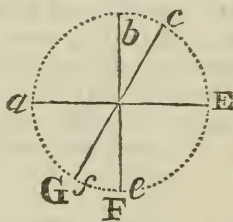
3^{dly}. Draw the Lines P K Q L R M S N, and H O, and they will divide the Line A B into 6 equal Parts, at the Points C D E F G, as requir'd.

Theorem.

If any 2 Right LINES cut thro' one another, as A E cut by b F or c G, then are the opposite or vertical Angles equal to one another.

For b F cutting A E at right

Angles, the Angle a B b, and b B d are equal, so also the Angle b B d is equal to the Angle d B e; and d B e to e B a; therefore they are all equal to one another, and therefore their opposite Angles are also equal; that is the Angle b B d is equal to the Angle e B a, and



the Angle a B b is equal to the Angle e B d, because the Arches a b, b d, d e e, a, by which they are measured, are severally and oppositely equal.

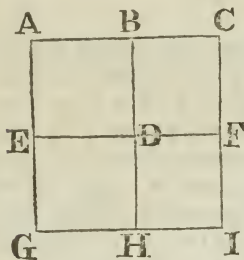
Again, The Angles c B d and a B f constituted by the Right Line c G, cutting A E in B are equal; because the Arches c d, being of the same Radius with

with the Arch f , a , and equal thereto, are therefore equal to one another. So also are the opposite Angles $a B c$, and $f B d$; because the Arch $A C$, is equal to the Arch $f d$. Q E D.

Theorem.

When a Right LINE is divided into 2 equal Parts, the Squares made of those Parts, are equal but to half the Square made by the whole Line.

This is evident; for the 2 Squares $A B E D$ and $B C D F$, made by the Squares of

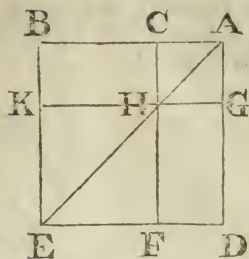


the 2 equal Parts of the Line AC , are equal but to half the Square, $A C G I$, made by the Square of the whole Line AC ; because that the other 2 Squares, $D H F I$, and $E D G H$, are equal unto them. Q E D.

Theorem.

When a Right LINE is divided by Chance into 2 unequal Parts, the Square of the whole Line is equal to both the Squares made of the Parts; and to the 2 Parallelograms, comprehended under the same Parts also.

That is, if the Right Line $B A$ be accidentally divided in C , I say that the Square $A B D E$, is equal to the Squares



made of the Parts ($A C G H$, and $H K F E$) and the 2 Parallelograms $C B H K$, and $G H D F$ also, whose opposite Sides are equal to the unequal Parts of the divided Line $A B$; because that the whole is equal to all its Parts taken together; which being evident, needs no further Demonstration.

Corollary.

Hence it appears, that the Parallelograms comprehended under the unequal Parts of the Line $A B$, are equal to one another.

For since that the Diagonal $A H E$ doth divide the Square into two equal Parts, and thereby the Triangle $A B E$, is made equal to the Triangle $A D E$; so is also the Triangle $A C H$, equal to the Triangle $A G E$; and the Triangle $H K E$, to the Triangle $H F E$.

Now if from the 2 Triangles $A B E$ and $A D E$ you subtract or take away the equal Triangles $A C H$, $A G H$, $H F E$ and $H K E$, the Remains will be equal; for if from equal Quantities you take away equal Quantities, the Quantities remaining will be equal.

Note, That the Squares $A C G H$ and $H K F E$, are generally

rally call'd the Parallelograms, about the Diameter A E; but may be more properly call'd the Squares about the Diagonal A E; because they are really Squares, and not Parallelograms; and the Line A E is a Diagonal common to them both, and not a Diameter, as it is call'd by *Euclid*, in his fourth Proposition of his Second Book.

The Parallelograms C B H K, and G H D F, are call'd the Supplements or Complements of the two Squares A C G H, and H K F E, to the whole Square A B D E.

LINE of Direction [in *Mechanicks*] is that according to which a Body endeavours to move.

Horizontal LINE [in *Perspective*] is the common Section of the Horizontal Plane, and that of the Draught or Representation, and which passes through the principal Point.

Geometrical LINE [in *Perspective*] is a Right-line drawn any how on the Geometrical Plane.

Terrestrial LINE [in *Perspective*] is a Right-line wherein the Geometrical Plane and that of the Picture or Draught intersect one another.

Terrestrial LINE [in *Perspective*] which is also called the *Base Line*, or *Line of the Plane*, is the Line that an Object is plac'd or stands upon, whereof each Object has its particular one, and the whole Draught a general one.

This is always parallel to the Horizon, and sometimes serves

to determine the Lengths and Breadths, particularly that at the Bottom of the Piece, where to all the Measures are to be accommodated.

Objective LINE [in *Perspective*] is the Line of an Object from whence the Appearance is sought for in the Draught or Picture.

LINE of the Front [in *Perspective*] is the common Section of the vertical Plane and of the Draught.

LINE of Station [in *Perspective*] is, according to some Writers, the common Section of the vertical and geometrical Planes. Others mean by it the perpendicular Height of the Eye above the geometrical Plane: Others a Line on that Plane and Perpendicular to the Line expressing the Height of the Eye.

LINE of Gravitation of any heavy Body [in *Mechanicks*] is a Line drawn through its Centre of Gravity, and according to which it tends downwards.

LINE of Direction of Motion of any Body, is that according to which it moves, or which directs and determines its Motion.

LINEAR Numbers [in *Arithmetick*] are such as have Relation to Length, as *v. gr.* such as represent one Side of a plane Figure; and if the plane Figure be square, the linear Number is called a *Root*.

LINEAR Problem [in *Mathematicks*] is such an one as may be solved geometrically by the Intersection of two Right-lines; as to measure an inaccessible

cessible Height, by means of two unequal Sticks: This is also call'd a Simple Problem, and is capable but of one Solution.

LINTEL [in *Architecture*] the Piece of the Timber that lies horizontally over Door Posts and Window Jambs, as well to bear the Thickness of the Wall over it, as to bind the Sides of the Walls together.

The Price.] Carpenters commonly put in these by the Foot running Measure, as 6 *d.* per Foot, if Oak; and 4 *d.* if Fir, for Timber and workmanship.

LIST [in *Architecture*] is a little square Moulding, serving to crown or accompany a larger; or on occasion to separate the Flutings of a Column. It is sometimes called *Listella* and *Filler*, and sometimes a *Square*.

LISTEL [in *Architecture*] a small Band, or a kind of Rule in the Mouldings; also the Space betwixt the Channellings of Pillars.

LOBBY. See *Antichamber*.

LOCAL PROBLEM [in *Mathematicks*] is such an one as is capable of an infinite Number of different Solutions; so that the Point which is to resolve the Problem, may be indifferently taken within a certain Extent. As suppose any where in such a Line, within such a plain Figure, &c. which is called *Geometrical Locus*, and the Problem is said to be a local or indeterminable one; and this local Problem may be either, *Simple*, when the Point sought is in a Right; *Plane*, when the Point sought is in the Circum-

ference of a Circle; *Solid*, when the Point required is in the Circumference of a Conic Section; or lastly, *Surfsolid*, when the Point is in the Perimeter of a Line of the higher Kind or second Gender, as Geometers call it.

LOCKS for *Doors* are of various Kinds; as for outer Doors, called Stock-locks; for Chamber-doors, call'd Spring-locks, &c. also the several Inventions in Locks, *i. e.* in contriving and making their Wards and Guards, are almost innumerable.

And as their Kinds are various, so are their Prices. I shall at present only mention some of the Chief, as

Stock Locks plain, from 10 *d.* to 14 *d.* per Piece, or more.

S Bitted Stock Locks, with a Pipe, 18 *d.* per Piece.

S Bitted and warded Stock Locks very strong, 7 *s.*

Brass Locks, from 5 *s.* 6 *d.* to 9 *s.*

Brass-knobbed Locks in iron Cates, 3 *s.*

Double Spring-Locks, 1 *s.*

Closet-door Locks, 1 *s.* 4 *d.*

Pad or Secret Locks, with Slits, instead of Pipes, 1 *s.*

Plate Stock Locks, 3 *s.* 8 *d.*

Some ditto for half that Price.

Plate Stock Locks in Skute, 4 *s.* 6 *d.*

Brass-knobbed Locks in Skute, 6 *s.* 6 *d.*

Iron rimmed Locks, very large, 10 *s.*

Mr. Chamberlain in his *Present State of Britain*, tells us that there are some Locks made of

of Iron and Brass of 50, nay 100 *l.* per Lock.

LOAM, a Sort of reddish Earth, used in Buildings (when tempered with Mud, Gelly, Straw, and Water) for plaistering Walls in ordinary Houses.

LOGARITHMS, are Numbers in arithmetical Progression, so fitted to the natural Numbers, that if any two natural Numbers are multiply'd and divided by one another, the Logarithms of these natural Numbers, that is, of those answering them, be added to, or subtracted from each other, the Sum or Remainder will be the Logarithm of the Product, or the Quotient of those two natural Numbers.

LONGIMETRY, the Art of measuring Lengths or Distances; or of taking the Distances of Trees, Steeples or Towers, &c. either one or many together.

LOGISTICAL Arithmetick was formerly the Arithmetick of Sexagesimal Fractions.

LUNES } [in *Geometry*]

LUNULÆ } are Spaces contained under a Quadrant of a Circle and a Semi-Circle; being called thus, because they represent the Figure of the Moon, when less than half full.

LUTHERN, or *Dormer*, a kind of Window over the Cornice, in the Roof of a Building; standing perpendicularly over the Naked of a Wall; and serving to illumine the upper Story.

The *French* Architects distinguish these into various Kinds, according to their various Forms; as *squares*, *semi-circu-*

lar, *Bulls Eyes*, *flat Arches*, *Flemish Lutherns*, &c.

M.

MACHINE [in *Mechanicks*] an Engine; is whatsoever has Force sufficient, either to raise or stop the Motion of a Body; or it may be defined any thing that serves to augment or regulate moving Powers; or it is any Body destin'd to produce Motion, so as to save either Time or Force.

These Machines are either *simple*, or *compound*.

Simple Machines are commonly reckoned to be six in Number, *viz.* the *Ballance*, *Lever*, *Pully*, *Wheel*, *Wedge*, and *Screw*. To these might be added inclin'd Planes; since 'tis certain that the heaviest Bodies may be lifted up by the Means thereof, which otherwise could scarce be moved.

Compound Machines, or Engines, are innumerable, in regard that they may be made out of the *Simple*, after almost infinite manners: And yet the Ancients seem to have outdone the Moderns in this respect; their Machines of Architecture, &c. being describ'd as vastly superior to ours.

A Machine for Building, is an Assemblage of Pieces of Wood, so disposed as that by means of Ropes and Pullies a small Number of Men may raise vast Loads or Weights, and lay them in their Places; as Cranes, &c.

'Tis hard to conceive what

Machines the Ancients must have used to raise these immense Stones found in some of the antique Buildings.

Hydraulick, or *Water MACHINE*, is either used to signify a *Simple Machine*; serving to conduct or raise Water; as a Sluice, Pump, &c. or several of these acting together, to produce some extraordinary Effect; as the Machine of *Marli* in *France*; the *Primum Mobile* or first Mover of which is an Arm of the River *Seine*, which by its Stream turns several large Wheels, which work the Handles, and these with Pistons raise the Waters up into the Pumps; and with other Pistons force it up in Pipes against the Ascent of an Hill to a Reservoir in a Stone Tower, 62 Fathoms higher than the River, sufficient to supply *Versailles* with

a constant Stream, 200 Inches in Diameter.

MAGIC SQUARES, the several Numbers that compose any Square (as suppose 1, 2, 3, 4, 5, &c. to 25 inclusive, which compose the Square Number 25.) being dispos'd after each other in a square Figure of 25 Cells, each in its Cell. If then you change the Order of these Numbers, and dispose 'em in the Cells in such manner, as that the five Numbers which fill any horizontal Rank of Cells, being added together, shall make the same Sum with the five Numbers in any other Rank of Cells, whether horizontal or vertical; and even the same Number with the 5 in each of the two Diagonal Ranks; this Disposition of Numbers is called a *Magic Square*, in opposition to the former, which is called a *Natural Square*.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

16	14	8	2	25
3	22	20	11	9
15	16	4	23	17
24	18	12	10	1
7	5	21	19	13

Or a *Magick Square* is when Numbers in arithmetical Proportion are disposed into such Parallel and equal Ranks, as that the Sums of each Row, as well diagonally as laterally shall be equal: Thus,

These nine Numbers, 2, 3, 4, 5, 6, 7, 8, 9, and 10, being

disposed into this square Form, they do every way directly and diagonally make the same Sum.

5	10	3
4	6	8
9	2	7

MAGNE.

MAGNETISM, is the *magnetical Attraction*, or the Virtue and Power that the Magnet or Loadstone has of drawing Iron to it.

MAGNITUDE, is the same as Bigness or Greatness. It is any thing that has Parts external, to Parts, connected together by some common Term; *i. e.* any thing locally extended or continued; or that has several Dimensions.

The Origin of all Magnitude is a Point, which though void of Parts it self, yet its Flux forms a Line; the Flux of that a Surface, and of that, a Body.

Literal **MAGNITUDE**, is a Magnitude expressed by Letters.

Numerical **MAGNITUDE**, is a Magnitude expressed by Numbers.

A Broken **MAGNITUDE**, is a Fraction.

A Complex **MAGNITUDE**, is that form'd by Multiplication.

An incommensurable **MAGNITUDE**, is a Magnitude that has no Proportion to Unity.

MALLEABLE, something hard and ductile, and that may be beaten, forged and extended under the Hammer.

All Metals are malleable, excepting Quicksilver; but Gold in the greatest Degree of all.

MALLET, a kind of large Hammer, made of Wood, much used by Artificers who work with the Chissel; as Sculptors, Masons, and Stone-cutters, whose Mallet is commonly round; Carpenters, Joiners, &c. who use a square one.

MALTHA, a kind of Co-

ment, anciently in great use, composed of Pitch, Wax, Plaster, and Grease.

Besides this, the *Romans* had another kind of *Maltha*, with which they plaistered and whitened the Inside of their Aqueducts. This was a very fine Cement, consisting of Lime slak'd in Wine, incorporated with melted Pitch and fresh Figs.

The *Natural* **MALTHA** is a kind of Bitumen with which the *Asiatics* plaister their Walls.

MANTLE [*in Architecture*] is the lower Part of the Chimney, or that Part laid across the Jambs, and which sustains the Compartment of the Chimney Piece.

MARBLE, is a kind of Stone, extremely hard, firm, and solid, dug out of Pits or Quarries: It takes a beautiful Polish, cuts very hardly, and is much used in Ornaments of fine Buildings: as Columns, Altars, Statues, &c.

There is an infinite Number of different kinds of Marble, usually denominated, either from their Colour, the Country where produced, or their Effects: Some are of one simple Colour; as *white*, or *black*; others streak'd or variegated with Stains, Clouds, Waves, &c.

All *Marbles* are opaque, except the white, which when cut into thin Slices, becomes transparent.

Marbles are also different in Weight and Hardness, and are to be considered with regard to their *Colour*, their *Country*, their *Grain*, and their *Defects*.

African Marble, is either of

a reddish Brown, streak'd with Veins of *white*; or of a *Carnation*, with Veins of *green*.

English White Marble is vein'd with *Red*.

Marble of Brabançon in Hamault, is black-vein'd with *White*.

Marble of Auvergne in France is of a pale *red*, mingled with *violet*, *green* and *yellow*.

Brocatelle Marble, is mingled with little Shades of *Isabella*, *yellow*, *pale* and *gray*. This comes from *Tortosa* in *Spain*, where it is dug out of an ancient Quarry.

There is also another sort of *Brocatelle*, which is digged up near *Adrianople*.

Marble of Champagne resembles the *Brocatelle*, being mix'd with *Blue*, in round Stains, like the Eyes of *Partridges*.

Marble of Bressè in Italy, is *yellow*, with Spots of *white*.

Marble of Carrara, on the Coasts of *Genoa*, is very *white*, and the fittest of all others for Works of Sculpture.

Cipollini or *Cipollin Marble*, is of a *Sea green* Colour, mix'd with large Waves or Clouds of *white*, or pale *green*.

Scamozzi thinks this is the same that the Ancients called *Augustum* and *Tiberium Marmor*, because first found in *Egypt*, in the Times of *Augustus* and *Tiberius*.

Lumachello Marble, is so call'd because mingled with Spots *grey*, *black*, and *white*, wreathed somewhat like *Periwinkle Shells*. This is ancient, and its Quarry is lost.

Marble of Margosse in the Milanese, has a *white* Ground with *brownish* Veins, resembling the Colour of *Iron rust*. This is very common, and extremely hard.

Marble of Dinan near Liege, is of a pure black, very beautiful, and very common.

Marble of Guachenet, near Dinan, is of a reddish *brown*, with *white* Spots and Veins.

Marble of Namure is black, like that of *Dinan*, but less beautiful, as inclining a little to the *blue*, and traversed with little Streaks of *grey*. This is very common, and is frequently used in Paving.

Marble of Thou, near Namure in Liege, is of a pure black, soft and easy to work, and receives a more beautiful Polish than those of *Namure* and *Dinan*.

Marble of Languedec, is of a vivid *red*, with large *white* Veins or Stains, and is very common. There is some whose *White* borders pretty much on the *blue*, and is less valued.

Marble of Lavée in Maine, has a black Ground, with little narrow Veins of *white*. There is another sort of it *red*, with Veins of a dirty *white*.

Marble of Ratrice in Hamault, is of a dirty *red*, mix'd with *blue* and *white* Clouds and Veins. This is pretty common, but different in Beauty.

Marble of Savoy is of a deep *red*, mix'd with other Colours; each Piece of which seems cemented on to the rest.

Parian Marble is antique, and much celebrated in Authors.

It is of a beautiful *white*: The greatest Part of the *Grecian* Statues were made of it. *Varro* calls it *Lychnites*, because the Workmen dug it out of the Quarry by Lamp light.

Marble of Sicily, is of a brownish *red*, stain'd with oblong Squares of *white* and *Isabella*, like strip'd *Taffetas*. The antient has very vivid Colours, and the modern comes pretty near it.

Marble of Porta Santa, at *Rome* called *Serna*, is mingled with large Clouds and Veins of *red*, *yellow*, and *grey*.

Marble of Signan in the *Pyreneans*, is ordinarily of a *greenish* brown, with *red* Stains, though this is somewhat various in its Colour.

Marble Portor has a *black* Ground, with Clouds and Veins of *yellow*. It is dug out of the Foot of the *Alps*, near *Car-rara*.

Black Attic Marble, is of a pure *black*, without Stains, and softer than the modern *black*. There was some of it brought from *Greece*, called *Marmor Luculleum*; but this was not so much valued as that which the *Egyptians* brought from *Ethiopia*, approaching to an iron Colour, and call'd *Basaltes*, or Touch-stone, because it serv'd them for the Trial of Metals.

Marble Bigio Nero, is antique.

Antient Black and White Marble, is now very rare, the Quarries of it being intirely lost. It is divided between a pure *white*, and a bright *black*, in Plates.

White - vein'd Marble, has large Veins with *grey*.

White Marble, dug out of the *Pyreneans*, on the Side of *Bayonne*, is inferior to that of *Car-rara*, its Grains being larger, and shining like a kind of Salt. It is something like the antient white *Greek Marble*, whereof their Statues were made, but not so hard and beautiful.

Marble Fior di Persica, comes from *Italy*, and consists of *red* and *white* Stains, somewhat *yellowish*.

White and Black Marble, has a pure *black* Ground, with some very white Veins.

Blue Tunquin Marble is mix'd with a dirty sort of *white*, and comes from the Coast of *Genoa*.

Yellow Marble is a kind of *Isabella* yellow without Veins; it is antique, and now very rare.

The *Modern Green Marble*, improperly call'd *Egyptian Marble*, is brought from *Car-rara*, on the Coast of *Genoa*: It is a deep *green*, spotted with *grey*.

Green Marble Antique, is a Mixture of *Grass green* and *black*, in Clouds of unequal Forms and Sizes, and is very rare, the Quarries being lost.

Marble Occhio di Pavone, or Peacock's Eye, is mingled with *red*, *white*, and *blueish* Clouds, somewhat resembling the Eyes at the end of a Peacock's Tail.

Marble denominated from its Defects.

Rigid MARBLE, is that which being too hard, is wrought with

Difficulty, and is apt to splinter, as the *black* Marble of *Nature*.

Thready MARBLE, is full of Threads or Filaments.

Brittle MARBLE, is what crumbles under the Instrument; as the *White Greek Marble*, and that of the *Pyrenæans*, &c.

Terras MARBLE, is that which has soft Places in it, which must be filled up with Cement; as that of *Languedoc*.

There are two Defects frequent in *Marbles*, which make them the more difficult to be cut and polished: The one is what Workmen sometimes call *Nails*, which answers to the Knots in Wood: The other, call'd *Emeril*, is a Mixture of Copper, or other Metal, making *black* Stains in the Marble. The *Emerils* are only common to white Marbles; but the Knots to all.

Under the Genus of MARBLE is comprehended *Porphyry*, which is the hardest, and which was antiently brought from *Numidia* in *Africa*. The most beautiful is that whose *red* is the most vivid, and the Stains the whitest and the smallest. See *Porphyry*.

The *Serpentine* PORPHYRY, which is a *greenish brown*, so called, because figured with little Stains. It is form'd of a great Number of Grains of Sand condensed: It is of various Kinds, as *Egyptian*, *Italian*, *Violet*, and *Green*. See *Serpentine*.

Jasper, of which there are various Kinds; the *Antient*, the *Florid*, the *Black*, the *White*, &c.

ALABASTER, of which there are various Kinds, both white and variegated.

They are all soft, when taken out of the Quarry, but harden in the Air.

Uses.] The principal Uses of Marble in Architecture is for Chimney-pieces, Chimney Foot-paces, Window-stools, Pavements, &c.

Pliny and other Authors tell us that the Antients used to face their Houses all over with thin Plates of Marble.

Of polishing Marble.] Some lay three or four Blocks in a Row; and with another, fix'd to a broad Beetle, and a Handle fixed at oblique Angles, with Sand and Water between, work the upper Stone backwards and forwards on the lower ones, till the Strokes of the Ax are worn off; after which they polish them with Ivory and Putty.

Sometimes to polish Tomb Stones, they block up the Stones to be polish'd, so as to lie horizontal about $2\frac{1}{2}$ Foot high above the Ground, and being laid very level, they work the upper Surface very smooth and even with a Tool for that Purpose.

This Tool is a Piece of whole Deal, about 18 or 20 Inches long, and 12 Inches broad, and cross the Grain of the Wood on the upper Side are nail'd 2 Ledges on, at each End; and on these Ledges is nail'd a Staff or Handle, about 8 or 9 Foot long (enough to reach the Length of the Tomb-Stone) also at each End of the under

Side

Side is nail'd a Ledge, and between those Edges is wedg'd in (with wooden Wedges) a Hearth Stone of Marble, unpolish'd and very rough.

They fling Water and Sand upon the Tomb-Stone, and work it (by drawing the Hearth Stone to and fro) till the Hearth Stone becomes pretty smooth; then they take that out, and put in another rough Hearth Stone; and this they continue to do till they have wrought the Tomb-Stone pretty even and smooth.

But while the Tomb-Stone and Hearth Stones are rough, they lay a considerable weight (as a Stone or the like) upon the upper Side of the Tool, to keep it down hard on the Tomb-Stone; but when the Tomb-Stone is pretty smooth, they make it yet smoother, by putting into the Tool, one after another, several of those Hearth Stones already begun to be polish'd, and this they continue to do, till they have brought both them and the Tomb-Stone to a more smooth polish. Upon these they use no weight on the back of the Tool, but they use Water and Sand as before; and if they have no Marble Hearth Stones to polish, they put a Purbeck Stone into the Tool.

The Price of Chimney Pieces] of black fleak'd Marble, or of Rance or Liver colour'd Marble, is worth, of an ordinary Size, 12 or 14 *l.* a Piece.

Window Scols of black or white fleak'd Marble, are worth about 25. 6d. per Foot.

Pavements of black or white Marble is worth about 2 *s.* per Foot.

English white Marble vein'd with Red, &c. is sold for about 25. 6d. per Foot in Squares for Pavements, and Slabs of the same Sort of Marble (long enough for Chimney Foot paces) for 55. per Foot.

Egyptian Marble vein'd with Variety of Greens in Slabs, 8s. per Foot.

Italian white Marble; for Chimney Foot Paces in Squares, for about 25. 6d. per Foot; in Slabs, for 55. per Foot, and black Marble is something cheaper.

Of Staining Marble.] Father Kircher shews the Manner of applying Colours on Marble, so as to make them penetrate its whole Substance, inasmuch that if the Marble be slit into several parallel Tables or Planks, the same Image will be found on each, that was painted on the first.

Spots of Oil penetrate white Marble, so that they cannot be taken out.

The *Stuck* whereof they make Statutes, Busts, Basso Relievo's, and other Ornaments of Architecture, is only Marble pulveriz'd, mix'd in a certain Proportion with Plaster; the whole well sifted, work'd up with Water, and us'd like common Plaster.

There is also a Sort of artificial Marble made of *Gypsum*, or a transparent Stone resembling Marble, which becomes very hard, receives a tolerable polish, and may deceive the Eye.

There

There is also a Sort of Marble form'd by corrosive Tinctures, which penetrating into white Marble to the Depth of a Line, imitates the various Colours of other Marbles.

Polish'd Marble is that which having been well rubb'd with Free-Stone, and afterwards with Pumice Stone, is at last polish'd with *Emery*, if the Marble be of several Colours; and if white, with Tin.

In *Italy* they polish with a Piece of Lead and Emery.

MARBLE COLOUR [in *Painting*.] That which is ordinary on new Stuff, is about 1 s. *per* Yard, and an old Colour about 5d. *per* Yard for Colour and Work.

MARQUETRY or *Inlaid Work*, is a Work compos'd of several fine hard Pieces of Wood of different Colours, fastened in thin Slices on a Ground, and sometimes enrich'd with other Matters, as Tortoise Shell, Ivory, Tin and Brass.

There is also another Kind of Marquetry made of Glasses of various Colours, instead of Wood; and also a third compos'd of nothing but precious Stones and the richest Marbles; but these last are rather call'd *Mosaic Work*.

The Art of Inlaying is very antient, and is suppos'd to have pass'd from *Asia* to *Europe*, as one of the Spoils brought from the Eastern Conquests by the *Romans* into *Italy*. It was indeed at that Time but a simple Thing, nor did it arrive at any tolerable Perfection before the fifteenth Century in *Italy*, nor

did arrive at its Height till the 17th Century among the *French*.

The finest Works of this Kind were only black and white, which we now call *Moreasco's*, till *John* of *Verona* Cotemporary with *Raphael*; but that Religious who had a Genius for Painting, stain'd his Woods with Dyes or boil'd Oils, which penetrated them.

But he went no farther than the Representations of Buildings and Perspectives, which require not any great Variety of Colours.

Those who came after him, not only improved on the Invention of dying the Woods, by a Secret they discovered of burning without consuming them, which serv'd exceedingly well for Shadows; but had also the Advantage of a Number of fine new Woods, of naturally bright Colours, by the Discovery of *America*.

With those Assistances the Art is now capable of imitating any Thing; whence it is by some call'd the *Art of Painting in Wood*.

The Ground on which the Pieces are to be arrang'd and glued, is usually of well dry'd Oak or Fir, and is compos'd of several Pieces glued together to prevent its warping.

The Wood to be us'd in Marquetry, is reduc'd into Leaves of the Thickness of a Line, *i.e.* the twelfth Part of an Inch is either stain'd with some Colour, or made black for Shadow; which some perform by putting it into Sand

extreamly heated over the Fire; others by steeping it in Lime Water, and Sublimate; and others in Oil of Sulphur.

Being thus colour'd, the Contours of the Pieces are form'd, according to the Parts of the Design they are to represent.

This last is the most difficult Part of Marquetry, and that which requires the most Patience and Attention.

The two chief Instruments us'd in this Work, are the Saw and the Vice; the latter to hold the Matters to be form'd, and the other to take off from its Extremes, as Occasion requires.

The Vice is of Wood, having one of its Chaps fix'd, the other moveable, and is open'd and shut by the Foot, by Means of a Cord fasten'd to a Treddle.

The Leaves to be form'd (for there are frequently 3 or 4, or more, of the same Kind, form'd together) are after they have been glued on the outermost Part of the Design, whose Profile they are to follow, put within the Chaps of the Vice; then the Workman pressing the Treddle, and thus holding fast the Piece with his Saw, runs over all the Out-Lines of the Design.

By thus joining or forming 3 or 4 Pieces together, not only Time is sav'd, but also the Matter is the better enabled to sustain the Effort of the Saw, which how delicate soever it may be, and how slightly soever the Workmen may conduct it, except this Precaution were taken, would be apt to raise

Splinters, and ruin the Beauty of the Work.

When the Marquetry is to consist of one single Kind of Wood, or of Tortoise Shell on a Copper or Tin Ground, or *Vice versa*, they only form 2 Leaves, one on another, *i. e.* a Leaf of Metal, and a Leaf of Wood or Shell: This is call'd sawing in Counterparts; for by filling the Vacuities of one of the Leaves, by the Pieces coming out of the other, the Metal may serve as a Ground to the Wood, and the Wood to the Metal.

All the Pieces having been thus form'd by the Saw, and mark'd in Order to their being known again, and the Shadow given in the Manner before mentioned, each is vanneer'd or fasten'd in its Place on the common Ground, with the best *English* Glue.

This being done, the whole is set in a Press to dry, and planed over and polish'd with the Skin of the *Sea-Dog*, wax and shave grave, as in simple vaneeering,

But withal with this Difference, that in Marquetry, the fine Branches, and several of the more delicate Parts of the Figures, are touch'd up and finish'd with a Graver.

Cabinet Makers, Joiners, &c. work in Marquetry; Stone-Cutters and Enamellers, deal in *Mosaic*.

MASON is a Person employed under the Direction of an Architect, in the raising of a Stone Building.

The chief Business of a Mason

son is to make the Mortar, raise the Walls from the Foundation to the Top, with the necessary Retreats and Perpendiculars to form the Vaults, and employ the Stones, as deliver'd to him.

When the Stones are large, the Business of hewing or cutting them, belongs to the Stone-Cutters, though these are frequently confounded with Masons; the Ornaments of Sculpture, are perform'd by Carvers in Stone, or Sculptors.

The Tools or Implements principally us'd by them, are, the Square, Level, Plumb-Line, Revel, Compass, Hammer, Chissel, Mallet, Saw, Trowel, &c. Besides the common Instruments us'd in the Hand, they have likewise Machines for raising of great Burdens, the conducting of large Stones, &c.

MASONRY is a Branch of *Architecture*, consisting, as it is defin'd by some, in the Art of hewing or squaring of Stones, and cutting them level and perpendicular for the Uses of *Building*: tho' in a more limited

Sense of the Word, *Masonry* is the Art of assembling and joining Stones together with Mortar.

Whence there arise as many different Kinds of Masonry, as there are different Forms and Manners of laying or joining Stones.

Vitruvius mentions 7 Kinds of *Masonry* among the Ancients, 3 of hewn Stone, *viz.* That in Form of a *Net*; that in binding, and that call'd the *Greek Masonry*; and 3 of unhewn Stones, *viz.* that of an *equal Course*, that of an *unequal Course*; and that fill'd up in the middle; the seventh was a Composition of all the Rest.

MASONS Work is sometimes measured by the superficial Foot, and sometimes by the solid Foot; and in some Places Walling is measured by the Rood, which is 21 Feet in Length, and 3 in Height, which makes 63 square Feet.

Example 1. If a Wall be 97 Feet 5 Inches in Length, and 18 Feet 3 Inches in Height, and 2 Feet 3 Inches thick, how many solid Feet are contain'd in that Wall?

F.	I.
97	5
18	3
<hr/>	
776	
97	
24	: 4 : 3
6	: 0 : 0
1	: 6 : 0
<hr/>	
1777	: 10 : 3
2	: : 3
<hr/>	
3555	: 8 : 6
444	: 5 : 6 : 9
<hr/>	
4000	: 2 : 0 : 9

97.417
18.25
<hr/>
487085
194834
779336
97417
<hr/>
1777.86025
2.25
<hr/>
888930125
355572050
355572050
<hr/>
4000.1855625

The Length, Height and Thickness being multiply'd together, the last Product is 4000 Feet 2 Inches, the solid Foot contain'd in the Wall.

By Scale and Compasses.

Extend the Compasses from 1 to 1.825, and that Extent

F.	I.
107	: 9
20	: 6
<hr/>	
2155	: 0
53	: 10 : 6
<hr/>	
2208	: 10 : 6

Facit 2208

will reach from 97.417 to 1777.86; then extend them from 1 to 1777.86, and that Extent will reach from 2.25, to 4000, 18. the solid Content.

Example 2. If a Wall be 107 Feet, 9 Inches long, and 20 Feet 6 Inches high, how many superficial Feet does it contain?

107.75
20.5
<hr/>
53875
12550
<hr/>
2208.875

Feet, 10 Inches.

By Scale and Compasses.

Extend the Compasses from 1, to 107.75, and that Extent will reach from 20.5 to 2208.875. the superficial Feet.

F.	I.
112	: 3
16	: 6
<hr/>	
676	: 0
112	
56	: 1 : 6
<hr/>	
1852	: 1 : 6

Facit 29 Roods, 25 Feet.

Example 3. If a Wall be 112 Feet 3 Inches in Length, and 16 Feet 6 Inches in Height, how many Roods does it contain.

112
16.5
<hr/>
56125
67350
11225
<hr/>
63) 1852.125 (29
<hr/>
592
<hr/>
25

By Scale and Compasses.

Extend the Compasses from 63 to 16.5, and that Extent will reach 112.25, to 29.460 Roods the Content.

Net MASONRY, call'd *Reti-culation*, from its Resemblance to the Meshes of a *Net*, consists of Stones squar'd in their Courses, and so dispos'd, as

that their Joints go obliquely, and the Diagonals are the one perpendicular, and the other level: This is the most agreeable Masonry to the Eye, but it is apt to crack.

Bound MASONRY, is that in which the Stones were plac'd one over another like Tiles; the Joints of their Beds being level,

Level, and the Mounters perpendicular: So that the Joint that mounts and separates two Stones, fall directly over the middle of the Stone below. This is less beautiful than the *Net Work*, but is more solid and durable.

Greek MASONRY (according to *Vitruvius*) is that, where after 2 Stones have been laid, each of which makes a Course, another is laid at the End, which makes 2 Courses, the same Order being observ'd throughout the Building, this may be called *Double Building*, in Regard that the binding is not only of Stones of the same Course with one another; but likewise of one Course with another Course

MASONRY by equal Courses; this was by the Ancients call'd *Isodorum*, and differs not from bound *Masonry*; but only in this, that its Stones are not hewn.

MASONRY by unequal Courses, which the Ancients call'd *Pseudisodorum*, was also made with unhewn Stones, and laid in *Bound Work*; but then they are not of the same Thickness, nor is there any Equality observ'd, excepting in the several Courses; the Courses themselves being unequal to each other.

MASONRY fill'd up in the middle, which the Ancients call'd *Emplecton*, is likewise made of unhewn Stone, and by Courses; but the Stones are only set in Order as to the Courses; the Middle being fill'd up with Stones thrown in at Random among the Mortar.

Compound MASONRY, is so call'd, as being form'd of all the Rest. In this the Courses are of hewn Stone, and the middle Place left void, fill'd up with Mortar and Pebbles thrown in together. After which, the Stones of one Course, are bound to those of another Course, with Cramp-Irons, fasten'd with melted Lead.

All the Kinds of *MASONRY* now in Use, may be reduc'd to these 5, viz. *Bound Masonry*, that of *Brick-Work*, where the Bodies and Projectures of the Stones inclose square Spaces or Pannels, &c. set with Bricks: That of *Moilon*, or small Work, where the Courses are equal, well squared, and their Edges or Beds rusticated; that where the Courses are unequal; and that fill'd up in the middle with little Stones and Mortar.

MASQUE [in *Architecture*] is us'd of certain Pieces of Sculpture, representing some hideous Form, Grotesque or Satyrs Faces, &c. us'd to fill up and adorn some vacant Places, as in Freezes, the Pannels of Doors, Keys of Arches, &c. but especially in Grotto's.

MASTICOTE is a good, light yellow, for most Uses, especially in making Greens, of which there may be several Sorts made out of this Colour, by mixing it with Blues. This Colour grinds very fine, and bears a good Body.

MATHEMATICKS } originally
MATHESIS } signify'd any Discipline or Learning; but now 'tis properly that Science

Science which teaches or contemplates, whatever is capable of being numbred or measured, as it is computable or measurable.

And the Part of Mathematicks, which relates to Number only, is call'd *Arithmetick*; that which relates to Measure in general, whether Length, Breadth, Motion, Force, &c. is call'd *Geometry*.

Mathematicks may be distinguished into *Simple* and *Mix'd*.

1. *Pure, Simple*, or *Abstracted*; which considers abstracted Quantity, without any Relation to Matter or sensible Objects; or

Mixt Mathematicks, which are interwoven every where with Physical Considerations; or it considers Quantity as subsisting in material Beings.

Mathematicks are also divided into *Speculative* and *Practical*.

1. *Speculative*, which proposes only the simple Knowledge of the Thing proposed, and the bare Contemplation of Truth, or Falshood. And

Practical, which teaches how to demonstrate some thing useful, or to perform something that shall be proposed for the the Benefit and Advantage of Mankind.

MEAN or *middle Proportion*, between any two Numbers or *Lines*, is that which hath the same Proportion.

Thus 6 is a Mean Proportional between 4 and 9, because $4 : 6 :: 6 : 9$.

The Square of a Mean Proportional is equal to the Rect-

angle under the Extremes.

Two Mean Proportionals between two Extremes cannot be found by a strait Line and a Circle; but it may very easily be done by the Conick Sections, &c.

MEASURE [in *Geometry*] any certain Quantity assumed as one or Unity, to which the Ratio of other Homogeneous or Similar Quantities is expressed.

MEASURE of a *Number* [in *Arithmetick*] is such a Number as divides another without leaving any Fraction. Thus 9 is a Measure of 27.

MEASURE of a *Line*, is any right Line taken at Pleasure.

MEASURE of a *Figure*, or *plain Surface*, is a Square or Side of any determinate Length. Among Geometricians 'tis usually a *Perch*, called a *square Perch*, divided into 10 square Feet, and the square Feet into square Digits: Thence call'd *Square Measures*.

MEASURE of a *Solid*, is a Cube whose Sides are of any Length at Pleasure.

MEASURE of an *Angle*, is an Arch describ'd from the *Vertex* in any Place between its Legs.

MEASURE of *Velocity* [in *Mechanicks*] is the Space passed over by the moving Body in a given Time.

MEASURE of the *Mass* or *Quantity of Matter* [in *Mechanicks*] is its Weight.

MEASURING [Geometrically defin'd] is the assuming any certain Quantity, and expressing the Proportion of other similar

similar Quantities to the same : But *popularly* defin'd, Measuring is the using a certain known Measure, and determining thereby the precise Extent, Quantity or Capacity of any Thing.

MEASURING [in the General] makes the practical Part of *Geometry*, from the various Subjects wherein it is employ'd : It acquires various Names, and constitutes various Arts.

MEASURING of *Lines* or Quantities of one Dimension is called *Longimetry* ; and when those Lines are not extended parallel to the Horizon, *Altimetry* ; when the different Altitudes of the two Extremes of the Lines are alone regarded, it is called *Levelling*.

MEASURING of *Superficies* or Quantities of two Dimensions, is denominated variously according to its Subjects. When it is conversant about Lands, it is called *Surveying* ; in other Cases, *simple Measuring*.

MEASURING of *Solids*, or Quantities of three Dimensions, is called *Stereometry* ; when it is conversant about the Capacities of Vessels, or the Liquors they contain particularly, *Gauging*.

MECHANICKS, is the *Geometry* of Motion, being that Science which shews the Effect of Powers or moving Forces, so far as they are applied to Engines, and demonstrates the Laws of Motion.

MECHANIC Powers, are the five simple Machines, to which all others, how complex soever, are reducible, and of the Assemblage thereof they are all compounded.

MECHANICAL *Affections* of Matter, are such Properties of Matter as result from their Figure, Bulk, and Motion.

MECHANICAL *Solution* of a Problem [in *Mathematicks*] is either when the Thing is done by repeated Trials ; or when the Lines made use of to solve it, are not truly Geometrical.

MEDIATE or *Intermediate*, is a Term of Relation to two Extremes, applied to a third, which is in the Middle.

MEMBRETTO [in *Architecture*] an *Italian* Term for a *Pilaster*, that bears up an Arch : These are often fluted, but not with more than seven or nine Channels. They are frequently used to adorn Door-Cases, Gallery Fronts, and Chimney Pieces, and to bear up the Corniches and Freezes of Wainscot.

MENSURABILITY, is an Aptitude in a Body whereby it may be applied or conformed to a certain Measure.

MENSURATION, or Measuring, is the Art or Act of finding the Superficial Area or solid Content of Surfaces or Bodies.

METOCHE [in *Antient Architecture*] is a Term used by *Vitruvius* to signify the Space or Interval between the Dentils.

METOPE } [in *Architecture*]
METOPA } is the Interval or square Space between the Triglyphs of the Freeze of the *Doric*, which among the Antients us'd to adorn those Parts with carved Work or Painting, representing the Heads of Oxen, and other Utensils of the heathen Sacrifices.

As there is found some Difficulty in disposing the *Triglyphs* and *Metopes*, in that just Symmetry that the *Doric* Order requires, some Architects make it a Rule, never to use this Order, but in Temples.

METOPES. *M. le Clerc* says, the Beauty of them consists in their Regularity, that is, in their being perfect Squares: And yet, when they are really square, they appear to be less in Height than in Breadth; which is owing to the Projection of the little *Bandelet* wherein they terminate underneath, which hides a small Part of their Height: For which Reason he makes the *Metopes* a Minute or two more in Height than in Breadth; being of Opinion they ought rather to appear square, without being so, than to be really so, without appearing so.

He also observes, that when the *Triglyphs* and *Metopes* follow each other regularly, the Columns must only stand one by one; exempting those of the inner Angles, which ought always to be accompanied with two others, one on each Side; from which the rest of the Columns may be placed at equal Distances from each other: And it is to be observ'd, that these two Columns, which accompany that of the Angle, are not less necessary on the account of the Solidity of the Building, than of the Regularity of the Intercolumniations.

Semi-Metope, is a Space somewhat less than half a *Metope* in the Corner of the *Doric*

Freeze. The Word *Metope* in the original *Greek* signifies the Distance between one Aperture or Hole and another; or between one *Triglyph* and another; the *Triglyph* being supposed to be Solives or Joists that fill the Apertures.

MEZZANINE, a Term us'd by some Architects, to signify an *Entresole*.

The Word is borrowed from the *Italians*, who call those little Windows which are less in Height than in Breadth, which serve to illuminate an Attic or an *Entresole*, *Mezzanine*.

MILLION [in *Arithmetick*] the Number of ten hundred thousand, or a thousand thousand.

MINUTE [in *Architecture*] is the 30th or 60th Part or Division of a Module; as a Module is usually the Diameter of the lower Part of a Column.

MITCHELS, are *Purbeck* Stones for paving, peck'd all of a Size, from 15 Inches square to two Foot, being squar'd and hew'd ready for Paving. They are said to be sold at 2 s. 10 d. per Foot.

MIXT Number [in *Arithmetick*] is that which is partly an Integer, and partly a Fraction; as $6\frac{3}{4}$.

MIXT Figure [in *Geometry*] is that which consists partly of right Lines, and partly of curved ones.

MODEL [in *Architecture*] is particularly used in Building for an artificial Pattern made in Wood, Stone, Plaister, or other Matter, with all its Parts and Proportions, in order for the

better conducting and executing some great Work, and to give an Idea of the Effect it will have in large ; or it may be defin'd a small Pattern of a House, &c. made by a small Scale ; wherein an Inch, or half an Inch represents a Foot, for the more exactly carrying on the Design.

In all large Buildings it is much the surest way to make a *Model* on *Relievo*, and not to trust to a bare Design or Draught.

MODERN [in *Architecture*] is improperly applied to the present, or *Italian* Manner of building ; as being according to the Rules of the *Antique* ; nor is the Term more properly applied, when attributed to *Architecture* purely *Gothic*.

Modern Architecture, strictly speaking, is only applicable to that which partakes partly of the antique, retaining somewhat of its Delicacy and Solidity, and partly of the *Gothic* ; whence it borrows Members and Ornaments without any Proportion or Judgment.

MODILLIONS [in *Architecture*] are Ornaments in the Cornish of the *Ionic*, *Corinthian*, and *Composite* Columns.

The *Modillions* are small Consoles or Brackets, under the Soffit or Bottom of the Drip of the Cornish, seeming to support the *Larmier*, tho' in Reality they are no more than Ornaments.

They ought always to be plac'd over the Middle of the Column. They are particularly affected in the *Corinthian* Order, where they are usually enrich'd with Sculpture.

The *Modillion* is usually in the Form of an S inverted, and fitted to the Soffit of the Cornish.

The Proportion of *Modillions* ought to be so adjusted as to produce a Regularity in the Parts of the Soffits.

The *Inter - Modillions*, i. e. the Distances between them, depend on the inner Columns, which oblige the *Modillions* to be made of a certain Length and Breadth, in order to make the Intervals perfect Squares, which are always found to have better Effect than Parallelograms.

Also in adjusting the *Modillions*, Care is to be taken that they have such a Proportion, as that when the Orders are plac'd over one another, there be the same Number in the upper Order as in the lower, and that they fall perpendicular over one another.

Modillions are also used under the Cornishes of Pediments, tho' *Vitruvius* observes that they were not allowed of in his Time, because *Modillions* were intended to represent the Ends of Rafters. *Daviler* rather takes them for a kind of inverted *Consoles* or *Corbels*.

The *Modillions* are also sometimes called *Mutules* ; tho' Use has introduced a little Difference between the Idea of a *Modillion* and a *Mutule* ; the *Mutule* being peculiar to the *Doric* Order ; and the *Modillions* to the higher Orders.

In the *Ionic* and *Composite* Orders, *Modillions* are more simple, having seldom any Ornaments,

ments, except sometimes a single Leaf underneath.

M. *Le Clerc* observes on the *Corinthian* Order, that it is usual to have a Leaf that takes up their whole Breadth, and almost their whole Length too.

But he is of Opinion, that the *Modillions* would be more graceful, if this Leaf were less both in Length and Breadth.

For this Reason he incloses it between two Lists, wherein it seems, as it were, to be set, and out of which it never comes, but to form its Return against the little Wave of the *Modillions*, which it joins without hiding: From this Relation of the Leaf with the *Modillions*, the latter is render'd exceeding graceful.

The Leaf of the *Modillion* ought to be of the same Kind with those which make the Ornament of the Capital; which is a Rule not to be disregarded.

He likewise observes, that in measuring of the *Modillions* of the *Roman*, and the other Orders, are not barely concerted with a View to the just Proportion of those Parts, but also to establish a Regularity in the Parts of the Plafond or Soffit of the Cornice.

The Distance between one *Modillion* and another, depends on that between the Inter-columns; and that Distance obliges us to make the *Modillions* of a certain Height and Breadth; in Order to have the Spaces that separate them in the Soffit, perfectly square.

Not only because those Squares are more regular than

long Squares, but also because they may be continued uniform through the projecting and re-entering Angles, which long Squares are incapable of; as may be observ'd in the Buildings, made according to the Rules of *Vignola*.

Further, in making the Division of the Inter-*Modillions*, Care must be taken, that they have such a Proportion, as that when the Orders are plac'd over one another, the *Modillions* of the lower Order be found in the same Number.

He also observes, as to the Intervals of the *Modillions* of the *Spanish* Order, that they are farther apart than in the *Roman*, but less than in the *Corinthian*, which is a Thing necessary, in Order to be able, on Occasion, to place these Orders one over another.

For as any Order ought to be less high than that whereon it is plac'd; the *Corinthian* when plac'd over the *Spanish*, should be less than the *Spanish*, as that when plac'd over the *Roman*, should in like Manner be less than the *Roman*: So that the under Columns being bigger than the upper, the Bottom of the upper being bigger than the Top of the under, and yet their *Modillions* be found exactly over one another, which were Things impracticable, unless the *Modillions* were at the same Distance, proportional to the Orders.

Whence it may be observ'd, that it is not enough to compose beautiful Orders; but they must also be match'd and

adjusted to one another, if they are to go together, as 'tis frequently necessary they should do.

MODULE [in *Architecture*] is a certain Measure or Bigness taken at Pleasure, for regulating the Proportions of Columns, and the Symmetry or Distribution of the whole Building.

Architects generally chuse the Semi-Diameter of the Bottom of the Column for their *Module*, and this they subdivide into Parts or Minutes.

The *Module* of *Vignola*, which is a Semi-Diameter, is divided into 12 Parts in the *Tuscan* and *Doric*; and into 18, for the other Orders.

The *Module* of *Palladio*, *Scamozzi*, *M. Cambray*, *Desgodetz*, *Le Clerc*, &c. which is also equal to the Semi-Diameter, is divided into 30 Parts or Minutes in all the Orders.

The whole Height of the Column is divided by some into 20 Parts for the *Doric*, $22\frac{1}{2}$ for the *Ionic*, 25 for the *Roman*, &c. and one of these Parts, is made a *Module*, to regulate the Rest of the Building by.

There are two Ways of determining the Measures or Proportions of Buildings.

The *First* is, by a fixt Standard Measure, which is usually the Diameter of the lower Part of the Column, call'd a *Module*, subdivided into 60 Parts, call'd Minutes.

In the *Second*, there are no Minutes, nor any certain or stated Division of the *Module*;

but it is divided occasionally into as many Parts as are judg'd necessary.

Thus the Height of the *Attic* Base, which is half the *Module*, is divided into 3, to have the Height of the Plinth; or into 4 for that of the greater *Torus*, or into 6, for that of the lesser.

Both these Manners have been practis'd by the ancient, as well as the modern Architects; but the Second, which was that chiefly us'd among the Ancients, is in the Opinion of *M. Perrault*, the most preferable.

As *Vitruvius* has lessen'd his *Module* in the *Doric* Order, which is the Diameter of the lower Part of the other Orders, and has reduc'd that great *Module* to a mean one, which is the Semi-Diameter, the *Module* is here reduc'd to the third Part for the same Reason, *viz.* to determine the several Measures without a Fraction.

For in the *Doric* Order, besides that the Height of the the Base, as in the other Orders, is determin'd by one of these mean *Modules*; the same *Module* gives likewise the Heights of the *Capital*, *Architrave*, *Triglyphs*, and *Metopes*.

But our little *Module*, taken from the third of the Diameter of the lower Part of the Column, has Uses much more extensive; for by this, the Height of Pedestals, or Columns and Entablatures in all the Orders, are determined without a Fraction.

As then the great *Module* or Diameter

Diameter of the Column has 60 Minutes, and the mean *Module* or half the Diameter 30 Minutes, our little *Module* has 20.

MOMENT [in *Mechanicks*] is the same with Impetus or the Quantity of Motion in any moving Body; and sometimes it is us'd simply for the Motion it self. *Moment* is frequently defin'd by the *vis insita*, or the Power by which moving Bodies continually change Place.

MOMENTS [in *Geometry*] are the generative Principles of Magnitude; they have no determin'd Magnitude of their own, but are only inceptive thereof.

MONOPTERE [in the ancient *Architecture*] a Kind of Temple, round and without Walls, having a Dome, supported with Columns.

MONUMENT [in *Architecture*] a Building destin'd to preserve the Memory, &c. of the Person who rais'd it, or for whom it was rais'd. Such is a Triumphal Arch, a Mausoleum, a Pyramid, &c.

The first Monuments that were erected by the Ancients, were the Stones which were laid over Tombs, on which were cut the Names and Actions of the Deceas'd.

These Stones were distinguish'd by various Names, according as their Figures were different. The *Greeks* call'd those which were square in their Base, and were the same Depth throughout their whole Length, *Stelæ*; from whence our Square Pilasters or *Attic*

Columns were deriv'd.

Those which were round in their Base, and ended in a Point at Top, they call'd *Styles*, which gave Occasion to the Invention of diminish'd Columns.

Those which were square at the Foot, and terminated in a Point at the Top, in the Manner of a Funeral Pile, they call'd *Pyramids*.

To those whose Bases were more in Length than in Breadth, and which rose still lessening to a very great Height, resembling the Figure of the Spits or *Obelisks*, or Instruments which the Ancients us'd in roasting their Sacrifices, they call'd *Obelisks*.

MONOTRIGLYPH [in *Architecture*] a Term that signifies the Space of one Triglyph between two Pilasters or two Columns.

MORISCO WORK } a Kind
MORESK WORK } of an-
tic Work in Carving or Painting, done after the Manner of the Moors, consisting of several Grottesque Pieces and Compartments, promiscuously intermingled, not containing any perfect Figure of a Man or other Animal, but a wild Resemblance of Birds, Beasts, Trees, &c.

MORTAR } [in *Architec-*
MORTER } *ture*] is a Preparation of Lime and Sand, mixt up with Water, serving as a Cement, and us'd by Masons and Bricklayers in Building of Walls of Stone and Brick.

For Plaistering of Walls, they make their Mortar of
E 3 Lime,

Lime, and Ox or Cow Hair, tempered well together with Mortar.

Of making common Mortar] As to the Proportion of Lime and Sand to be us'd in making common Mortar, there are different Opinions.

Vitruvius says, you may put three Parts of Dug (or Pit-Sand) to one Part of Lime; but if the Sand be taken out of a River, or out of the Sea, then two Parts of it, and one of Lime. He also adds, that if to the River or Sea Sand, you put one third Part of Powder of Tiles or Bricks, it will work the better.

But *Vitruvius's* Proportion of Sand seems too much, tho' he should mean of Lime before it is slak'd; for one Bushel of Lime before 'tis slak'd, will make five Pecks, after 'tis slak'd.

About *London* (where for the most Part Lime is made of Chalk) they put about 36 Bushels of Pit Sand to 25 Bushels of Quick Lime, that is, about a Bushel and a half of Sand to a Bushel of Lime.

In some Places they put after the Proportion of three Pecks of Sand to one Bushel of Lime; in other Places a Bushel and half of Sand, to a Bushel of Lime.

In Effect, the Proportion of Lime to Sand in making of Mortar, ought to be according to the goodness or badness of these Materials, and is therefore rather to be regulated by the Judgment of experienc'd Workmen in each particular

Country, than by any stated Proportions of Materials.

As to the Method of making of Mortar], Some Workmen are of Opinion 'tis the best Way not to use Mortar as soon as it is made; nor (in making it) to make the Lime run before it is mix'd with the Sand (as some do) but rather to throw the Sand on the Lime while it is in the Stones, before it is run, and so to mix it together, and then to wet it; by which Means (they say) it will be the stronger, and when it has lain a while before it is us'd, will not be so subject to blow and blister.

Others advise to let Mortar (when made) lie in a Heap two or three Years before it is us'd, which they say, will render it the stronger and better; they likewise say, the using of Mortar as soon as 'tis made, is the Cause of so many insufficient Buildings.

Others advise, that in slaking of Lime, to wet it every where but a little (and not to over-wet it) and to cover every Laying or Bed of Lime (about the Quantity of a Bushel) with Sand, as you slake it; that so the Steam or Spirit of the Lime may be kept in, and not fly away, but mix it self with the Sand; which will render the Mortar considerably stronger, than if it were all slak'd at first, and the Sand thrown on altogether at last.

2. That all the Mortar should be well beaten with a Beater, three or four times over, before it is us'd, by that Means to break

break all the Knots of the Lime well together; and they say, that the Air which the Beater forces into the Mortar at every Stroke, conduces very much to the Strength of it.

3. That when you design to build well, or use strong Mortar for Repairs, you beat the Mortar well, and let it lie two or three Days, and then beat it well again, when it is to be us'd.

4. That Mortar be us'd as soft as may be in Summer Time; but pretty stiff or hard in Winter.

As to mixing and blending of Mortar, Mr. *Felibien* observes, that the ancient Masons were so very scrupulous herein, that the *Greeks* kept ten Men constantly employ'd for a long Space of Time, to each Bastion, which rendred it of such prodigious hardness, that *Vitruvius* tells us, the Pieces of Plaster falling off from old Walls, serv'd to make Tables.

And Mr. *Felibien* tells us, 'tis a Maxim among old Masons to their Labourers, that they should dilute it with the Sweat of their Brow, *i. e.* labour it a long Time, instead of drowning it with Water, to have done the sooner.

Mr. *Worldge* advises, that if you would have your Mortar strong, where you cannot have your Choice of Lime, but can chuse your Sand and Water, not to use that Sand that is full of Dust; for all dusty Sand makes the Mortar weaker; and the rounder the Sand is, the stronger the Mortar will be,

as is usually observ'd in Water drift Sand; that it makes better Mortar than Sand out of the Pit.

Therefore he advises, that if you have Occasion for extraordinary Mortar, to wash your Sand in a Tub, till the Water, after much stirring, comes off clear, and to mix that with new Lime, and the Mortar will be very strong and durable. And if the Water be foul, dirty, or muddy, the Mortar will be the weaker.

Wolfius observes, that the Sand should be dry and sharp, so as to prick the Hands when rubb'd; yet not earthy, so as to foul the Water it is wash'd in.

He also finds Fault with Masons and Bricklayers, as committing a great Error in letting their Lime slacken and cool before they make up their Mortar, and also in letting their Mortar cool and die before they use it; therefore he advises, that if you expect your Work to be well done, and to continue long, to work up the Lime quick, and but a little at a Time, that the Mortar may not lie long before it be us'd.

So that, it appears, Men differ in their Opinions in this Point; some affirming it to be best to work up the Mortar new, and others, not till it has lain a long Time.

A certain Author tells us, that an experienc'd Mason told him, that being at work at *Eridge-Place*, (at the Lord *Abergavenny's*) at *Fant in Suffex*, they would have him make

use of Mortar that had been made four Years. But when he came to try it, he said it was good for Nothing, because it was so very hard, that there was no tempering it. Upon which, a certain Jesuite (who resided in the House, and had been a great Traveller) told him, that to his Knowledge at several Places beyond Sea, they always kept their Mortar 20 Years before they us'd it; but then this Mortar was kept in Cisterns for the Purpose, and always moist.

The Ancients had a Kind of Mortar so very hard and binding, that after so long a Duration, 'tis next to impossible to separate the Parts of some of their Buildings; tho' there are some who ascribe that excessive Strength to Time and Influences of certain Properties in the Air, which is found to harden some Bodies very surprisngly.

De Lore observes, that the best Mortar is that made of *Puzzuoli*; adding, that it penetrates black Flints, and turns them white.

The Lime us'd in the ancient Mortar is said to be burnt from the hardest Stones, and even the Fragments of Marble.

As for the scaling (or crimping) of Mortar out of the Joints of Stone and Brick-Walls, some are of Opinion it proceeds from the badness of the Sand or Lime, or both, as well as from the Season of Year when Work is done.

Besides the common Mortar us'd in laying Stones, Bricks, &c. there are several other Kinds, as

White Mortar, us'd in Plastering the Walls and Ceilings, which are often first plastered with Loam, and is made of Ox or Cow Hair, mix'd and temper'd with Lime and Water, without any Sand.

The common Allowance in making this Kind of Mortar is one Bushel of Hair to six Bushels of Lime; the Hair serves to keep the Mortar from cracking; binding it, and holding it fast together.

The MORTAR us'd in making Water Courses, Cisterns, &c. is very hard and durable, as may be seen at *Rome* at this Day. It is us'd not only in Building of Walls, but also in making of Cisterns to hold Water, and all manner of Water Works, and also in finishing or Plastering of Fronts, to represent Stone Work.

There are two Kinds of it, the one is compounded with Lime and Hogs Grease, and mixt with the Juice of Figs; and the other is of the same Ingredients, but has liquid Pitch added to it, and is first wet or slak'd with Wine, and then pounded or beaten with Hogs Grease, and Juice of Figs.

That which has Pitch in it, is easily distinguish'd from the other by its Colour; and what is plastered with this Kind of Mortar, is wash'd over with Linseed Oil.

Mortar for Furnaces, &c. is made with red Clay, wrought in Water, wherein Horse Dung and Chimney Soot has been steep'd, by which a Salt is communicated to the Water, bind-

binding the Clay, and making it fit to endure the Fire : This Clay ought not to be too fat, lest it should be subject to Chinks; nor too lean or sandy, lest it should not bind enough.

Some Operators in Metal, use a Kind of Mortar to plaister over the Inside of their Vessels in which they refine their Metals, to keep the Metal from running out; and this Kind of Mortar is made with Quick-Lime and Ox-Blood; the Lime being first beaten to powder, and sifted, and afterwards mixt with the Blood, and beat with a Beater.

The Glass-makers in *France* are said to use a Sort of Mortar (for plaistering over the Insides of their Furnaces) which is made of a Sort of Fuller's Earth, which is procur'd at *Be-liere*, near *Forges*, which is the only Earth in *France* that has the Property of not melting in this excessive Heat; and also the Pots which hold the melted Metal, are made of this Sort of Earth, and will last a long Time.

Mortar for Sun-Dials on Walls, may be made of Lime or Sand tempered with Linseed Oil, and for Want of Linseed Oil, may be made of scumm'd Milk; but Oil is better : This spread upon the Wall, will harden to the hardness of a Stone, and not decay in many Years, and will endure the Weather six times as long as the ordinary Plaister, made of Lime and Hair with Water.

A certain Author says he has known a very strong and

tough Mortar (for a Sun-Dial Plane) has been made after the following Manner.

There was taken five or six Gallons of Brook Sand, and dry'd on an Oast; and after that sifted through a fine splinted Sieve, and then mix'd with it the same Quantity, or rather something more of sifted Lime, and a Gallon of Boreing (or Gun) Dust sifted also; these were all wetted and well tempered with six or seven Gallons of scumm'd Milk, and about two Quarts of Linseed Oil.

This was laid on the Wall first, well wetted with Milk; but this prov'd very troublesome to the Workmen to set it smooth; by Reason that it dry'd so very fast; but by keeping it often sprinkled with Milk, and smoothing it with the Trowel, it did at last set with a smooth and shining Surface.

But notwithstanding all his Care (as it dry'd) it crack'd pretty much, which might probably proceed from the Want of Hair to it; it did also blow Blisters, tho' the Lime was sifted : which probably might have been prevented, if the Lime had been prepar'd as for *Fresco Painting*.

Extraordinary good Mortar for Floors, Walls, Ceilings, &c.

Temper Ox Blood and fine Clay together, then lay the same in any Floor, or plaister any Wall or Ceiling with it, and it will become a very strong and binding Substance. This is said by some to be much us'd in *Italy*.

In Buildings one Part of waste Soap Ashes mix'd with another of Lime and Sand, make a very durable Mortar.

This Mortar may be made, as it was by a certain eminent Soap Boiler, who built himself a very handsome House with it in the following Proportions; two Load of waste Soap Ashes, one Load of Lime, one Load of Lome, and one of Sand.

Another Person of the same Trade us'd only Lime and Soap - Ashes, tempered and wrought together for Mortar; with which he laid both the Foundations, Chimnies, and their Tunnels, in his Dwelling-house in *Southwark*; which have endur'd and stood out those Storms which have overturn'd many other Tunnels, both new and old, which were built with common Mortar.

It is true indeed, this kind of Mortar is somewhat rough in the laying, and more sharp and fretting to the Fingers than common Mortar; which may be the Reason why it is so much neglected and decry'd by Workmen.

But these two Inconveniences might be easily remedied; and indeed its Roughness is so far from being a Fault, that it is rather an excellent Quality in the Mortar. But this may be remedied, by grinding or stamping the Soap-Ashes (which are in hard Cakes) to a fine Powder, before they are mix'd with the Sand, which will soon bring it to a smooth Temper.

Nor will the Charge be much; the Profit of one Day's Labour

will answer the Charge of three Mens Wages, in the Difference of Price that will be found betwixt one Load of these Ashes and one Hundred of Lime.

Secondly, As to the *Sharpness* wherewith it offends the Workmens Fingers, that may be avoided by wearing Gloves (without which they seldom lay any Brick at all) to avoid the like Effects which they find in Lime.

Or, for an assured Remedy in these Cases; these Ashes may be re-imbib'd in Water for a considerable Time, till more of their Salt be extracted from them; and then much of their fretting Nature being taken away, they will be found to be gentle enough.

For laying Tiles, in some Places they make a kind of Mortar of Lome and new Horse Dung well tempered and mix'd together: And this is by some Workmen accounted a good, strong, and cheap Mortar, which is more suitable to Tiles than the common Mortar made with Lime and Sand, which they say corrodes and frets the Tiles, and causes them to scale and fly to pieces; which this does not.

For the plaistering the Fronts of Houses in imitation of *Brick-work*; Some Workmen make Mortar for this sort of Work, of Powder of Brick, sharp Sand and Lime, and some red Oker. Some Houses plaistered with this kind of Plaister, look very well, tho' they have been done 20 or 30 Years, and may be taken, by one passing by, for a Brick House, tho' it be only Timber

Timber plaistered over. The Workman has for this sort of Work commonly 1 s. per Yard, only for Workmanship.

How much allow'd to a Rod of Brick-work, or a Square of Tileing.] Workmen usually allow a Hundred and half (or $37\frac{1}{2}$ Bushels) of Lime, and two Load (or 72 Bushels of Sand) to make Mortar enough for a Rod of Brick-work.

And for Tileing; four Bushels of Lime, and six or eight Bushels of Sand, will make Mortar enough for laying 1000 of Tiles, which is about a Square and a half; so that a Square of Tileing will take up, for Mortar, about $2\frac{2}{3}$ Bushels of Lime, and about five Bushels of Sand.

A Caution.] It is a general Caution in all Parts of a Building, that where either Stones or Bricks are contiguous to Wood, they ought to be laid, dry, or without Mortar; because Lime and Wood are unfociable; the Lime very much corroding and decaying the Wood.

MORTOISE? [in Carpen-
MORTISE } try, &c.] is a kind of Joint, wherein a Hole or Incision of a certain Depth is made, in the Thickness of a Piece of Wood, which is to receive another Piece, call'd a Tenon.

MOSAIC WORK? Is a cu-
MOSAIQUE } rious Piece of Work, or an Assemblage of Marble, pretious Stones, Pebbles, Pieces of Glafs, &c. also Cockles and Shells of various Colours, cut square, and cemented on a Ground of Stuck,

&c. in imitation of the natural Colour and Degradation of Painting.

As to the Name *Mosaic*, some derive it of *Musaicum*, as that is of *Musivum*, as it was call'd among the Romans. Scaliger derives it of *Mouſan*, Gr. and imagines the Name was given to this Sort of Work, as being fine and ingenious.

Mosaic Work seems to have taken its Origin from *Paving*. The fine Effect and Use of Pavements, compos'd of Pieces of Marble of different Colours, so artfully and neatly join'd together, that when the Work is dry, it may be polish'd, and the whole make a very beautiful and solid Body, which being continually trodden upon and wash'd with Water, was not at all damag'd, gave the Hint to the Painter, who in a little Time carried the Art to a much higher Degree of Perfection, so as to represent Foliages, and Grotesque Pieces of various Colours on a Ground of Marble, either white or black.

In fine, the good Effect of this Kind of Work in Pavements, being observ'd, and also its Quality of resisting Water, Artists proceeded farther, and also lin'd Walls with it, beautified with various Figures, for adorning Temples, and other publick Buildings.

But Nature not having produc'd a sufficient Variety of Colours for them in Marbles to represent all Kinds of Objects, they bethought themselves of counterfeiting them with Glafs and

and Metal Colours, they having given Tints of all Manner of Colours, to an infinite Number of Pieces of Glats and Metals to counterfeit Stones of various Colours, the Design succeeded so well; the Workmen arrang'd them with so much Art, that their Mosaic seem'd to almost vye with Paintings.

This Way of representing Objects having this Advantage that it resists the Injuries of the Air as well as Marble it self; and even grows more beautiful by Time; which effaces all other Kinds of Paintings.

But the Moderns have gone beyond the Ancients; and setting aside Materials of Glass and Metals, have intermixt with the finest Marbles, the richest of precious Stones; as *Agats, Cornelians, Emeralds, Lapis, Turquoises, &c.*

So that the Mosaic Work of Glass and Metals, is now little in Use; tho' even they are of a surprising Beauty and Durableness: But that which is in the most common Use, is that of Marble alone; the Mosaic of precious Stones being so very costly, that scarce any but very small Works are made with them: As Ornaments for Altar-Pieces, Tables for rich Cabinets, &c.

Tho' out of these must be excepted, that sumptuous Chapel of the Dukes of *Tuscany*, which has been so long in Hand, and which, if it be ever finish'd, will be a noble Monument of the Magnificence and Piety of those Princes, as well as the Patience and Address of the

Workmen employ'd in that Work.

Mosaic Work of Glafs.

This Work is begun with little Pieces of Glats, which they provide of as many different Colours as possible.

For this Purpose the Glafs-Makers Furnaces being prepar'd and put in Order, and the Pots or Crucibles full of the Matter of which Glafs is made, or rather of Glafs, already made; they put what Colours they think proper into each Crucible, always beginning with the weakest, and augmenting the Strength of the Colours from Crucible to Crucible, till they come to the deepest Shade or Teint, much after the Manner of mixing Oil Colours on a *Palette*. When the Glafs has been well melted and ting'd with all the Colours to Perfection, the Crucibles are taken hot out of the Furnace, and the Glats is poured on a smooth Marble, and so cut into Slices of an Inch and an half thick.

Then with an Instrument which the *Italians* call *Bocca di Cane*, they make some Pieces square, and others of different Figures and Sizes, according as the Design requires.

The Pieces are orderly disposed in Cases; as in Painting *in Fresco* it is usual to range all the different Tints in Shells, and according to their Colour.

If they would have a Gold Colour, either in the Ground of the Painting, or in the Ornaments, or the Draperies, they take

take some of the Pieces of Glass, form'd and cut in the Manner before mentioned. These they moisten on one Side with Gum Water, and afterwards lay Leaf Gold on it.

They then put this Piece, or several Pieces at a time, on a Fire-shovel; which they place in the Mouth of the Furnace, after having first covered them with another hollow Piece of Glass.

Here they continue till such Time as they become red hot; after which the Shovel is drawn out all at once, and the Gold becomes so firmly attach'd to the Glass, as never afterwards to be separated from it.

Now, to apply these several Pieces, and to form a Picture out of them, they have a Cartoon or Design first drawn: This is transfer'd on the Ground or Plaster by calking, as in painting *in Fresco*.

As this Plaster is to be laid thick on the Wall, it will continue fresh and soft a considerable time; so that there may be enough prepared at once to serve three or four Days.

This Plaster is composed of Lime, made of hard Stone, with Brick Dust made very fine, Gum Tragacanth, and Whites of Eggs. When this has been prepar'd and laid on the Wall, and the Design of what is to be represented drawn on it, they take out the little Pieces of Glass with Pliers, and range them one after another, still keeping strictly to the Light and Shadow, different Tints and Colours before represented

in the Design; pressing or flattening them down with a Ruler; which both sinks them within the Ground, and at the same time renders the Surface even.

After this manner, in much Time, and an almost infinite deal of Trouble, they at length finish the Work; which is still the more beautiful as the Pieces of Glass are the more uniform, and ranged at more equal Heights.

Some of these Pieces have been executed with so much Justness, that they appear as smooth as a Table of Marble; and as finish'd and as masterly as a Painting *in Fresco*; with this Advantage, that they have a fine Lustre, and will last almost for ever.

The finest Works of this Kind that have been preserved to our Time, and those from which the Moderns have retriev'd the Art, which was almost lost, are those of the Church of St. *Agnes*, formerly the Temple of *Bacchus* at *Rome*; at *Pisa*, *Florence*, and other Cities of *Italy*.

The most esteemed among the Works of the Moderns, are those of *Joseph Pine*, and the Chevalier *Lanfranc*, in the Church of St. *Peter* at *Rome*: But there are also very good ones at *Venice*.

Mosaic Work of Marble and precious Stones.

These two Kinds of *Mosaic* bear so near a Relation to each other as to the manner of working, that to avoid Repetition, I shall give them both under

under one; observing by the way, wherein the one is different from the other.

Mosaic of Marble is us'd in large Works, as in Pavements of Churches, Basiliks and Palaces; and Incrustation and vanneering the Walls of the same Edifices.

As to *Mosaic*, of or with Stones, especially *precious Stones*, it is only used in small Works, as has been before observ'd.

The Ground of *Mosaic* Works, wholly of Marble, is usually a massive Marble, either white or black. On this Ground the Design is cut with a Chisel, having been first calked.

When it has been dug of a sufficient Depth, *i. e.* an Inch, or more, 'tis filled up with Marble of a proper Colour, first contourniated or fashioned to the Design, and reduc'd to the Thickness of the Indentures with various Instruments.

To make the Pieces thus inserted into the Indentures, hold the several Colours which are to imitate those of the Design, they use a Stuck composed of Lime and Marble Dust; or a Mastick; which different workmen prepare different ways; after which the Work is half polish'd with a kind of soft Stone.

The Figures being mark'd out, the Painter or Sculptor himself draws with a Pencil the Colours of the Figures not determined by the Ground, and in the same manner makes Strokes or Hatchings in the Places where the Shadows ought to be; and when he has en-

graven with the Chisel all the Strokes thus drawn, he fills them up with a black Mastick, compos'd partly of *Burgundy Pitch*, poured on hot; afterwards taking off what is superfluous, with a Piece of soft Stone or Brick; which together with Water and beaten Cement takes away the Mastick, polishes the Marble, and renders the Whole so even, that it seems as if it consisted but of one intire Piece.

It is this kind of *Mosaic* that is seen in the pompous Church of the *Invalids* at *Paris*, and the fine Chapel at *Versailles*; and with which some intire Apartments of that Palace are incrustated.

As for *Mosaic Work of precious Stones*, other and more delicate Instruments are required, than those that are used in Marbles; as Wheels, Drills, Tin-plates, &c. such as Lapidaries and Engravers on Stone use.

As none but the richest Marbles and Stones enter this Work, in order to make them go the farther, they are sawn into the thinnest Leaves that can be, scarce exceeding half a Line in Thickness. The Block that is to be sawn, is fastened firmly with Cords on the Bench, only raised a little on a Piece of Wood of one or two Inches high.

The Saw is directed by two iron Pins, which are on one Side of the Block, and which also serve to fasten it; which with the Pieces so sawn are put into a Vice contrived for that
Pur-

Purpose; and with a kind of Saw, or Bow, made of fine Brass Wire, bent on a Piece of springy Wood, together with Emery steep'd in Water, the Leaf is gradually fashioned, by following the Strokes of the Design made on Paper, and glued on the Piece.

When there have been Pieces enough fastened to form an intricate Flower, or some other Part of the Design, they are applied. The Ground that supports this *Mosaic*, is usually of Free Stone. The Matter where-with the Stones are joined together, is a Mastick, or kind of Stuck, laid very thin on the Leaves as they are fashioned; and the Leaves in this State are applied with Pliers.

If any Contour or Side of a Leaf be not either rounded enough or squared enough to fit the Place where it is to be used; when 'tis too large, 'tis brought down with a Brass File or Rasp; and when too small, is manag'd with a Drill and other Instruments used by Lapidaries.

The Manner of making Mosaic Work of Gypsum.

The Gypsum is a kind of coarse Talc, or a shining transparent Stone found in the Quarries of *Montmartre* near *Paris*, among the Stones dug out of that Quarry, with which the Plaster of *Paris* is made. It is different from the Plaster; but retains the Name the *Romans* gave the Plaster, viz. *Gypsum*.

A kind of artificial Marbles are made of this Stone, calcin'd in a Kiln, and pounded in a Mortar, and afterwards finely sifted. These Marbles imitate precious Stones; and of these they compose a kind of *Mosaic* Work; which does not fall far short, either in Durableness or Vivacity, of the natural Stones; and besides, it has this Advantage, that it admits of continued Pieces or Paintings of intricate Compartments, without any visible Joinings.

Some make the Ground of Plaster of *Paris*; others of Free Stone. If it be made of Plaster of *Paris*, it is spread on a wooden Frame, of the Length and Breadth of the Work it is designed for, and about an Inch and half in Thickness. This Frame is so contrived that the Tenons being only joined to the Mortises by single Pins, they may be taken asunder, and the Frame dismounted when the Plaster is dry.

This Frame is covered on one Side with a strong linen Cloth, nail'd all around; which being plac'd horizontally, with the Cloth at the Bottom, is filled with Plaster pass'd through a wide Sieve.

The Plaster being grown half dry, the Frame is set up perpendicular, and let stand so, till it is quite dry; and then is taken out, by dismounting the Frame.

In this Kind of *Mosaic*, the Ground is the most important Part.

The

The Method of preparing this sifted *Gypsum*, which is to be apply'd on this Ground, is by dissolving and boiling it in *English* Glue, and afterwards mixing with it the Colour that it is to bear: The Whole being work'd up together in the ordinary Consistence of a Plaister; and then it is taken and spread on the Ground five or six Inches thick.

This is to be observ'd: If the Work be such as that Mouldings are requir'd, they are form'd with Gouges and other Instruments.

On this Plaister thus colour'd like Marble or precious Stone, and which is to serve as a Ground to a Work, either of *Lapis*, Agate, Alabaster, or the like, the Design to be represented is drawn; having been first pounced or calked, to hollow or impress the Design; the same Instrument is us'd as is us'd by Sculptors; the Ground on which they are to work not being much less hard than Marble it self. The Cavities being thus made in the Ground, are filled up with the same *Gypsum* boil'd in Glue; only differently colour'd: And after this manner are the Colours in the Original represented.

That they may have the necessary Colours and Tints at hand, they first temper Quantities of the *Gypsum* with the several Colours in little Pots.

When they have thus filled the Design, and render'd it visible by half polishing it with Brick or soft Stone, they go over it again, cutting such Places

as are either to be weaker or more shadowed, and filling them with *Gypsum*; which is repeated till all the Colours added one after another, represent the Original to the Life.

The Work being finish'd, is scowred with soft Stone, Sand, and Water; then with Pumice, and polish'd with a wooden Mullet and Emery.

Lastly, the Lustre is given it by smearing it over with Oil, and rubbing it a long Time with the Palm of the Hand; which gives it a Lustre nothing inferior to that of natural Marble.

If it be only requir'd to make a variegated Table, or other Work of several Colours, without *Mosaic* Figures, the Process is somewhat different.

To perform this, they only prepare separately as many different Colours as the Work requires, in Imitation of Marble: These are put into large Pans or Bowls, and after they have been incorporated in the *Gypsum* and Glue Water, they take a Trowel full of each, and dispose them in a Trough without any Order; then without mingling them, and only by cutting or crossing the *Gypsum* of each Trowel once or twice with each of the Rest, they give them that beautiful Confusion, which makes the Value of natural Marbles: Of these they make their Tables, or lay them in a Mould, according to the Work to be done.

MOSS [*us'd in Tiling*]. In some Places in the Country, they lay Tiles in Moss instead

of Mortar: But this is disap-
prov'd by some Workmen, be-
cause they say, in windy, wet
Weather, when the Wet, Rain,
Slow, or Sleet is driven under
the Tiles in the Moss, if a Frost
follows while the Tiles are wet,
it then freezes the Moss, and
so raises the Tiles out of their
Place.

MOTION is a continual and
successive Mutation of Place,
and is either Absolute or Rela-
tive.

1. *Absolute Motion* is the
Change of the *Locus Absolutus*
of any moving Body; and there-
fore its Celerity will be mea-
sured by the Quantity of the
Absolute Space, which the
moveable Body hath run thro'.
But,

2. *Relative Motion*, is a Mu-
tation of the Relative or Vul-
gar Place of the moving Body,
and so hath its Celerity ac-
counted or measured by the
Quantity of Relative Space,
which the moveable Body runs
over.

3. All Motion is of it self
rectilinear, or made according
to strait Lines, with the same
constant uniform Velocity, if
no external Cause makes any
Alteration in its Direction.

4. If two Bodies moving
uniformly, go with unequal Ve-
locities, the Spaces which will
be pass'd over by them in une-
qual Times, will be to one
another in a Ratio, compounded
of that of the Velocities, and
that of the Times.

5. The Motions of all Bo-
dies, are as the Rectangles un-
der the Velocities, and the

Quantities of Matter.

6. The Motions of Bodies
included in a given Space
among themselves, will not be
changed by the Motion of that
Space uniformly forwards in a
strait Line.

7. Every Body will continue
in its State, either of Rest or
Motion uniformly forward in a
right Line, unless it be made
to change that State by some
Force impress'd upon it.

8. The Change of Motion is
proportionable to the moving
Force impress'd, and is always
according to the Direction of
that Right Line, in which the
Force is impress'd.

9. The Quantity of any
Motion is discoverable by the
joint Consideration of the Quan-
tity of Matter in, and the Ve-
locity of the moving Body;
for the Motion of any whole is
the Sum of the Motions of all
the Parts.

10. The Quantity of Mo-
tion which is found by taking
either the Sum of the Motions
made the same Way, or the
Difference of those which are
made the contrary Ways is not
at all changed by the Actions
of the Bodies one upon another.

11. In all kind of Motions
whatever, *Rolling*, *Sliding*,
uniform, accelerated or retard-
ed, in right Lines or in Curves,
&c. the Sum of the Forces
which produce the Motion of
all Parts of its Duration, is al-
ways proportionable to the Sum
of the Paths or Lines, which
all the Points of the moving
Body describe.

12. The Product of the Du-
ration

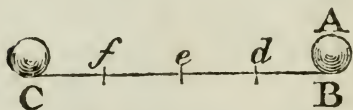
ration of all uniform Motion, multiply'd by the Force, which began the Motion, is always proportional to the Product made by the Path or Line of Motion, multiply'd by the Mass or Quantity of Matter in the moving Body.

MOTION [in *Mechanicks*] is the opposite to the Rest, it is either general or particular, and those are either Regular or Irregular.

Motion in general, is the *Change* of a Thing; and when that *Change* is made in the Quantity, it is call'd an *Increase* or *Diminution*.

Again, when the Change is made, in Respect to Place, it is call'd *Place Motion*, or *Local Motion*.

Local MOTION } [in *Mechanicks*]
Place MOTION }
 is the change of Place, or it is the continual Passage of a Body that moves from one Place, as the Passage of the Body A, from the Place B, into the Place C. For by its being mov'd to C, it has chang'd its Place from B to C.



Secondly, If the Body A, as it moves to C, goes through equal Spaces in equal Times, then its Motion is said to be *equal*; that is, if Bd is $= de$, and the Body A pass from B to d , in the same Time as it does from d to e , then it will have pass'd through equal Spaces in

equal Times, whereby its Motion is said to be *regular* or *equal*.

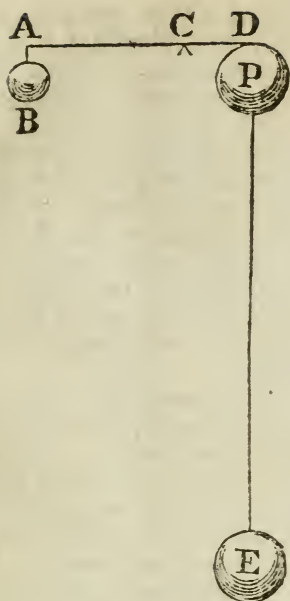
But if the Body A had mov'd from d to e , in less Time than it did from A to d , then its Motion had been irregular; because it would have pass'd through equal Spaces in unequal Times.

Hence, (as *Galileus* observes) an irregular Motion is natural to all heavy Bodies, which he justly terms a *Motion uniformly accelerated*, as a Body dropt from the Top of a Steeple to the Earth, which in equal Times, passes through unequal Spaces.

That is to say, that dividing the Time it takes up in falling into equal Spaces, as Minutes, Seconds, &c. The Velocity of the falling Body at the End of the second Minute, &c. is double what it was at the End of the first, being reckon'd from the Point or Beginning of its Rest or Fall.

And that the Velocity which it acquires in the third Minute, &c. is triple of that which it had at first. And the Velocity of the fourth Minute, &c. four times that of the first, and so on in like Proportion of all other.

Thus if in the first Minute a Body falls from a to b ; in the second Minute it will have fallen to c , and have pass'd thro' three times the Space of $a b$, which with the Space $a b$, is equal to four, which is the Square of two, the Number of Minutes.



First Minute

Second Minute

Third Minute

Fourth Minute

Fifth Minute

Sixth Minute

*Again.*

At the End of the third Minute it will have fallen to D, and have pass'd through five times the Space $a b$, which with the Space $a b$, and $b e$, is equal to 9, which is the Square of 3, the Number of Minutes or Time of falling; and so in

like Manner of all other Minutes, &c.

Hence it follows, that the Spaces through which Bodies, fall, are as the Squares of the Times or Minutes, &c. in falling; that is if in one Minute a Body falls one Foot.

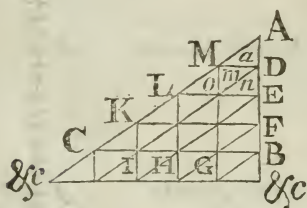
Then in	$\left\{ \begin{array}{c} 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \\ 9 \\ 10 \\ \text{\&c.} \end{array} \right\}$	It will have fallen	$\left\{ \begin{array}{c} 4 \\ 9 \\ 16 \\ 25 \\ 36 \\ 49 \\ 64 \\ 81 \\ 100 \\ \text{\&c.} \end{array} \right\}$	From the Point of Rest.
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Hence it is evident that the Increase of Motion in every Minute, &c. is according to the Series of the uneven Numbers, 1, 3, 5, 7, 9, 11, &c.

which are the Differences of the Squares, 1, 4, 9, 16, 25, 36, &c.

By the *fourth Prop. 6 Lib. Euclid.* similar ∇ are to one

another, as the Squares of their Homologus Sides; one may consider the Spaces pass'd thro' in equal Minutes as similar Triangles ∇ and the Minutes and Velocities, as the homologous Sides of those Triangles.



This is easily understood by the Triangular Figure above, which is suppos'd to be the Space pass'd through by the Body falling, which for Example Sake, is suppos'd to have fallen in four Seconds of Time, whose Measure is represented by the Side A B, equally divided at D E F B into four = Parts; and the Base B C shall likewise represent the Velocity which the Body has acquir'd in falling.

Now as each of the equal Parts, A D, D E, E, F, and F B, represent one Second of Time: so likewise, if B C be divided into four equal Parts, as B G, G H, H I, and I C, each of those Parts, will represent one Degree of Velocity, because 'tis suppos'd, that the Velocities and Seconds increase continually in the same Proportion.

Again.

If from the Points I H G, you draw Right Lines parallel to A C, and to A B, also intersecting A B in the Points D E

F, and A C in the Points M L K, the Triangle A B C will be divided into 16 little Triangles = one to another, and each similar to A B C.

Now since A D represents the first Second of Time, and D M the first Degree of Velocity: therefore the Triangle A D M, will represent the Space which the Body has pass'd through in the first Second, with one Degree of Velocity.

So likewise the Line A E, representing the Second of the Fall of the said Body, the Line E L will represent the Velocity which the Body has acquir'd in falling the Second Second of Time, and the Triangle A E L will represent the Space that the Body has pass'd thro' with two Degrees of Velocity, which triangular Space A E L is equal to four Times A D M; because the ∇a is = equal to the ∇m , and the triangle m , is equal to the ∇n , and the Triangle n is equal to the ∇o ; therefore the $\nabla A E L$, is equal to four times the $\nabla A D M$, and so in like Manner of all other equal Spaces of Time.

Hence it is evident, that the Velocity with which heavy Bodies descend, is according to the Squares of their Times;

So whatever Space a Body passes through, by falling in one Second, or one Minute, &c. So many times that first Space the Body falls, are equal to the Square of its times.

That is, if a Body falls one Foot in one Minute, then it will have fallen 100 Foot in 10 Minutes,

minutes, and 144 Foot in 12 Minutes, because 100 is the Square of 10, multiply'd by 10, and 144 is the Square of 12, multiply'd by 12.

MOULD [in *Mechanic Arts*] A Cavity artfully cut, with Design to give its Form or Impression to some softer Matter applied therein, and are Instruments of great use in Sculpture, Foundry, &c.

Workmen employ'd in melting the mineral or metallic Glebe dug out of Mines, have each their several Mould, to receive the melted Metal as it comes out of the Furnace; but different according to the Diversity of Metals and Works.

In the Gold Mines they have Moulds for Ingots, in Silver Mines for Bars, in Copper or Lead Mines for Pigs or Salmons, in Tin Mines for Pigs and Ingots, and in Iron Mines for Sows, Chimney-Backs, Anvils, Caldrons, Pots, and other large Utensils and Merchandizes of Iron, which are here cast, as it were at the first Hand. See **CENTRE**.

MOULDINGS [in *Architecture*] are Projectures beyond the naked of a Wall, Column, Wainscot, &c. the Assemblage of which, forms Cornishes, Door-Cases, and other Pieces of Architecture, which only serve for Ornament; whether they be square, round, strait or crooked: Of these there are seven Kinds more considerable than the Rest, viz. the *Doucine*; the *Talon* or *Heel*; the *Ovolo*, or *Quarter Round*; the *Plinth*, the *Astragal*, the *Den-*

ticle, and the *Cavetto*.

Some *Mouldings* are crown'd with a *Fillet*, others are without, as the *Doucine*, *Talon*, *Ovolo*, *Torus*, *Scotia*, *Astragal*, *Gula*, *Coro: a*, &c.

Again, Some are adorn'd with Sculptures, either hollowed, or in Relievo.

Mouldings [in *Architecture*] are what Letters are in *Writing*. By the various Dispositions and Combinations of *Mouldings*, may be made an infinite Number of different Profiles for all Sorts of Orders and Compositions, regular or irregular, and yet all the Kinds of *Mouldings* may be reduc'd to three, viz. square, round, and mixed; i. e. compos'd of the other two.

For this Reason, those who invented the *Gothick* Architecture; resolving to recede from these perfect Figures, and affecting to use others less perfect, to distinguish their Architecture from the Antique, introduc'd a new Set of whimsical *Mouldings* and Ornaments.

Regular *Mouldings* are either large, as *Doucines*, *Ovolos*, *Gulas*, *Talons*, *Scotia's*, &c. or small, as *Fillets*, *Astragals*, *Conges*, &c.

Mr. *Le Clerc* says, that Ornaments are not always us'd on *Mouldings*, barely to enrich them, but sometimes also to enrich, and sometimes also to distinguish them the better from one another.

As the Generality of *Mouldings*, and in particular those of Cornishes are only illumin'd by Reflection, they would be frequently confounded and lost, if

they were all simple and uniform; but a few Ornaments cut some one Way, and some another, distinguish them advantageously from each other.

Thus the Eggs have a noble Effect underneath the Larmier of the *Ionick* Order, or underneath the square Member, whence the *Modillions* proceed in the *Corinthian*, as in his Figure 67; because those Ornaments, being cut strong and bold, make an agreeable Difference between the *Mouldings* that accompany them.

Among these Ornaments, some stand prominent from the *Mouldings*, and others are cut within them, as may be observ'd in the several Figures of his 118 Plate.

Ornaments, he says, are not to be bestow'd indifferently every where upon *Mouldings*; some Members or *Mouldings*, must be reserv'd plain to set off the Rest, and without the Simplicity and Plainness of these, the Richness of Ornaments would only make a Confusion in Architecture, a sensible Instance of which we have in the *Corinthian* Profile taken from the Baths of *Dioclesian*, and mention'd in the Parallel of *M. de Chambray*. The *Corona* for Instance, is the first master *Moulding* in the *Corniche*, which will not admit of Ornaments, the *Faces* of the *Architrave*, the *Fillets*, *List* or *Listels*, the *Astragal*, and all the Parts of the *Base*.

MOULINET [in *Mechanicks*] 'tis us'd to signify a *Roller*, which being cross'd with 2 *Levers*, is

usually apply'd to *Cranes*, *Capstans* and other Sorts of *Engines* of the like Nature, to draw *Cords* and raise *Stones*, *Timber* & such like heavy *Materials*. Also a kind of *Turn-Stile* or wooden *Cross*, which turns horizontally upon a *Stake* fix'd in the *Ground*, and is usually plac'd in *Passages* to keep out *Horses*, and oblige *Passengers* to go and come one by one.

MOVEMENT [in *Mechanicks*] is the same that is by some call'd an *Autometon*, and with us signifies all those Parts of a *Clock*, *Watch* or any such curious *Engine*, which are in *Motion*, carry on the *Design*, or answer the *End* of the *Instrument*.

MULTANGULAR Figure or Body, is one that has many *Angles* or pointed *Corners*.

MULTILATERAL [in *Geometry*] is said of those Figures which have more than four *Sides* or *Angles*.

MULTINOMIAL *Roots*, [in *Mathematicks*] are such as are compos'd of many *Names*, *Parts* or *Members*.

MULTIPLE } [in *Arith-*
MULTIPLEX } *metick*].
a Number which comprehends some other Number several Times.

Thus 6 is a *Multiple* of 2; or which is the same; 2 is a *quota* Part of 6; 2 being contained in 6, 3 times, and thus 12 is a *Multiple* of 6, 4, 3, and comprehends the first, twice; the second, three Times, and the third, four times.

MULTIPLE *Proportion*, is when the antecedent being divided by the Consequent, the Quotient is more than *Unity*; and the

the Reason of the Name is, because the Consequent must be multiply'd by the Index or Exponent of the Ratio to make it equal to the Antecedent.

Thus 12 is the *Multiple* in Proportion to 4, because being divided by 4, the Quotient is 3, which is the Denomination of the Ratio; and the Consequent 4 being multiply'd by 3, makes the Antecedent 12, wherefore 3, is the *Sub-multiple* of 12.

A *Sub-multiple* Number is that contain'd in the *Multiple*, thus, the Number 1, 2, and 3, are *Sub-multiples* of 6 and 9.

MULTPLICAND [in *Arithmetick*] is the Number to be multiply'd.

MULTIPLICATOR is the Number by which you multiply, or the Number multiplying.

MULTIPLICATION, is in general, the taking or repeating of one Quantity, as often as there are suppos'd Unites in the other Number; the Number multiply'd is call'd the *Multiplicand*, the Number multiplying, the *Multiplicator*, and that which is found or produc'd is call'd the *Product*.

Multiplication is only a compendious Addition, effecting at once, what in the ordinary Way of Addition would require many Additions; for the *Multiplicand* is only added to itself or repeated as often as the Unites of the *Multiplicator* do express it.

Thus if 6 were to be multiply'd by 4, the Product is 24, which is the Sum arising from the Addition of 6 four times to itself.

In all Multiplication, as 1 is to the Multiplier, so is the Multiplicand to the Product.

Cross MULTIPLICATION, or Multiplication of Feet and Parts.

Example 1. Let 7 Feet 9 Inches be multiply'd by 3 Feet 6 Inches.

F.	I.
7	9
3	6
<hr/>	
23	3 Pts.
3	10 6
<hr/>	
27	1 6
<hr/>	

First, multiply 9 Inches by 3, saying 3 times 9 is 27 Inches, which make 2 Feet 3 Inches; set down 3 under Inches, and carry 2 to the Feet, saying 3 times 7 is 21, and 2 that I carry makes 23; set down 23 under the Feet.

Then begin with 6 Inches, saying, 6 times 9 is 54 Parts; which is 4 Inches and 6 Parts; set down 6 Parts, and carry 4, saying 6 times 7 is 42, and 4 that I carry is 46 Inches, which is 3 Foot 10 Inches, which set down, and add all up together, and the Product will be 27 Feet, 1 Inch, and 6 Parts.

Example 2. Multiply 75 Feet 7 Inches, by 9 Feet 8 Inches.

F.	I.
75	7
9	8
<hr/>	
680	3
50	4 : 8
<hr/>	
730	7 : 8
<hr/>	

First, Multiply by 9 Feet, saying 9 times 7 is 63, which is 5 Feet 3 Inches; set down 3 and carry 5, saying 9 times 5 is 45, and 5 I carry is 50; set down 0 and carry 5, saying 9 times 7 is 63, and 5 that I carry is 68, set down 68, and proceed to multiply by 8 Inches, saying, 8 times 7 is 56, the twelves in 56 are 4 times, and there remains 8; set 8 in a Place to the right Hand, and carry 4; then multiply 75 by 8, and the Product is 600, and 4 that I carry is 604, which divided by 12, the Quotient is 50 Feet, and 4 remains; then set down 50 Feet and 4 Inches, and add all together, and you will find the Product 730 Feet, 7 Inches, 8 Parts.

I shall shew another Way of working the last Example, which in my Opinion is better and more expeditious, when there are more Figures than one in the Feet, thus.

F.	I.
75	7
9	8
<hr/>	
680	3
25	: 2 : 4
25	: 2 : 4
<hr/>	
730	: 7 : 8
<hr/>	

Multiply by 9 Feet first, as above directed; then instead of multiplying by 8 Inches, let the 8 Inches be parted into such aliquot or even Parts of a Foot, as you find to be contain'd in that Figure; if you take such Parts of the Multiplicand and add them to the former Product, the Sum will give the Answer.

Thus 8 Inches may be parted into 4 and 4, because 4 is the third Part of 12. So that if you take the third Part of 75 Feet 7 Inches, and set it down twice and add all together, the Sum will be 730 Feet 7 Inches 8 Parts, the same as before.

Thus, say how often 3 in 7, which is twice, set down 2; then because twice 3 is 6, say 6 out of 7, and there remains 1, for which you must add 10 to the 5, and it makes 15; then the 3 in 15 are 5, set down 5, and because 3 times 5 is 15, there is 0 remains.

Then go to the 7 Inches, saying the threes in 7 are twice; set down 2 in the Inches; and because twice 3 is but 6, take 6 out of 7, and there remains 1 Inch, which is 12 Parts, then the threes in 12 are 4 times, and 0 remains. So the third Part of 75 Feet 7 Inches, is 25 Feet, 2 Inches, 4 Parts; which set down again, and add all together; and the Sum will be 730 Feet, 7 Inches, 8 Parts, the same as before.

Example 3. Let 97 Feet 8 Inches, be multiply'd by 8 Feet 9 Inches.

F.	I.
97	: 8
8	: 9
<hr/>	
481	. 4
48	: 10
24	: 5
<hr/>	
854	: 7
<hr/>	

Begin first to multiply 8 Feet, saying 8 times 8 is 64 Inches, that is 5 Feet 4 Inches; set down 4 Inches and carry 5, saying

saying, 8 times 7 is 56, and 5 I carry, is 61; set down 1 and carry 6, saying 8 times 9 is 72, and 6 I carry is 78, which set down: Then instead of multiplying by 9 Inches, take the Aliquot Parts of 12, which 9 makes, which is 6 and 3, 6 Inches being half 12, and 3 the fourth Part; therefore take the half of 97 Feet 8 Inches, which is 48 Feet 10 Inches; and because 3 is half of 6, you may take the half of 48 Feet 10 Inches, which is 24 Feet 5 Inches; add all up together, and the Sum is 854 Feet 7 Inches.

Example 4. Multiply 75 Feet 9 Inches, by 17 Feet 7 Inches.

F.	I.
75	9
17	7

525

75

25 : 3 parts.

18 : 11 3

8 : 6

4 : 3

1331 : 11 : 3

In this Example, because there are more than 12 Feet in the Multiplier, therefore I first multiply the 75 by 17 Feet, then because the Aliquot Parts in 7 Inches are 4 and 3, that is, a third and a fourth, take the third Part of 75 Feet 9 Inches, which is 25 Feet 3 Inches, and the fourth Part thereof is 18 Feet 11 Inches, 3 Parts, and then the Aliquot Parts of 9 Inches, are 6 and 3, that is a half

and a fourth; therefore I take half 17 Feet, which is 8 Feet 6 Inches, and the fourth, is 4 Feet 3 Inches (not meddling with the 7 Inches, because that was multiply'd into the 9 before) then add all these together, and the Sum is 1331 Feet, 11 Inches, 3 Parts.

Example 5. Let 87 Feet 5 Inches, be multiply'd by 35 Feet 8 Inches.

F	I.	P.
87	:	5
35	:	8

435

261

29 : 1 : 8

11 : 8 : 0

2 : 11 : 0

3117 : 10 : 4

Work this as the last Example; after you have multiply'd the Feet, then take the Aliquot Parts of 8 Inches, which is two thirds; therefore take the third Part of 87 Feet 5 Inches, which is 29 Feet, 1 Inch, 8 Parts; set this down twice; then the Aliquot Parts of 5 Inches, are 4 and 1, that is; a third Part and a twelfth Part; therefore take a third Part of 35, which is 11 Feet 8 Inches, and a twelfth Part of 35 Feet, is 2 Feet 11 Inches; set all these one under another, and add them together, and the Sum will be 3117 Feet, 10 Inches, 4 Parts.

Example 6. Multiply 259 Feet

Feet 2 Inches, by 48 Feet 11 Inches.

F.	I.	
259	:	2
48	:	11
<hr/>		
20072		
1036		
129	:	7 P.
86	:	4 : 8
31	:	7 : 2
8	:	0 : 0
<hr/>		
12677	:	6 : 10
<hr/>		

First. Multiply the Feet; then take the Aliquot Parts of 11, which will be 6 4 and 1; that is, a half, a third, and a twelfth; therefore take the half of 259 Feet, 2 Inches, which is 129 Feet 7 Inches, and a third Part is 86 Feet 4 Inches 8 Parts; and the twelfth Part of 259 Feet 2 Inches, is 21 Feet 7 Inches 2 Parts (or because 1 is the fourth Part of 4) you may more readily take the fourth Part of 86 Feet, 4 Inches 8 Parts) which is also 21 Feet, 7 Inches, 2 Parts; then add all together, and the Sum will be 12677 Feet, 6 Inches and 10 Parts.

To multiply Feet, Inches and Parts.

Example 1. Multiply 7 Feet 5 Inches, 9 Parts, by 3 Feet, 5 Inches, 3 Parts.

In this Example I first begin with 3 Feet, and there multiply 7 Feet, 5 Inches, 9 Parts; first I say, 3 times 9 is 27 Parts, that is 2 Inches and

3 Parts; set down 3 under the Parts, and carry 2, saying 3 times 5 is 15, and 2 I carry, is 17, that is 1 Foot 5 Inches, set down 5 Inches and carry 1, and say 3 times 7 is 21, and 1 I carry is 22; set down 22 Feet.

F.	I.	P.	
7	:	5	:
3	:	5	:
<hr/>			
22	:	5	:
3	:	1	:
		1	:
<hr/>			
25	:	8	:

9

3

S.

4 : 9

10 : 5 : 3

3

T

Then begin with 5 Inches, saying, 5 times 9 is 45, which is 45 Seconds, which make 3 Parts and 9 Seconds; set down 9 Seconds a Place towards the right Hand, and carry 3 Parts, saying 5 times 5 is 25, and 3 I carry is 28, which is 2 Inches and 4 Parts; set down 4 Parts, and carry 2, saying 5 times 7 is 35, and 2 I carry is 37, which is 3 Feet and 1 Inch; set down the 3 Parts and 1 Inch, and begin to multiply by 3 Parts, saying 3 times 9 is 27 thirds, that is 2 Seconds and 3 Thirds; set down 3 Thirds and carry 2, saying, 3 times 5 is 15, and 2 I carry is 17, that is 1 Part and 5 Seconds; set down 5 Seconds and carry 1. Saying 3 times 7 is 21, and 1 I carry, is 22; which is 1 Inch and 10 Parts, which set down and add all up together, and the Product will be 25 Feet, 8 Inches, 6 Parts, 2 Seconds, and 3 Thirds.

You

You are to take Notice, that in multiplying *Feet*, *Inches* and *Parts*, &c. if *Feet* be multiply'd by *Feet*, the Product is *Feet*; and *Feet* multiply'd by *Inches*, the Product is *Inches*, and the twelfth Part is *Feet*; and *Parts* multiply'd by *Feet*, the Product is *Parts*, and the twelfth Part thereof is *Inches*; *Parts* multiply'd by *Inches*, the Product is *Seconds*, and the twelfth Part thereof is *Parts*; and *Parts* multiply'd by *Parts*, the Product is *Thirds*, and the twelfth Part thereof, is *Seconds*.

So that if you begin to multiply *Parts* by *Feet* in the first Row, and *Parts* by *Inches* in the second Row, and *Parts* by *Parts* in the third Row, the first Figure in every Row will stand a Place more towards the Right Hand; as is to be seen in the last Example.

Example 2. Multiply 37 Feet 7 Inches, 5 Parts, by 4 Feet, 8 Inches, 6 Parts.

F.	I.	P.	
37	: 7	: 5	
4	: 8	: 6	
<hr/>			
150	: 5	: 8	S
12	: 6	: 5	: 8
12	: 6	: 5	: 8 T
1	: 6	: 9	: 8 : 6
<hr/>			
177	: 1	: 5	: 0 : 6

First. Multiply by 4 Feet, saying, 4 times 5 is 20, which is 1 Inch 8 Parts; set down 8 and carry 1, saying 4 times 7 is 28, and 1 I carry is 29, which is 2 Feet 5 Inches; set down 5 Inches, and carry 2, saying 4

times 7 is 28, and 2 I carried is 30; set down 0, and carry 3, and say 4 times 3 is 12, and 3 is 15; set down 15.

Then begin with 8 Inches; but because the Feet in the Multiplicand are more than 12, it will be the best Way to work for the Aliquot Parts of 8; so here work for 4 Inches, and set that down twice, 4 being the third Part of 12; therefore take the third Part of 37 Feet, 7 Inches, 5 Parts, which is 12 Feet, 6 Inches, 5 Parts, 8 Seconds: set this down twice.

Then begin with 6 Parts; but instead of multiplying, take half 37 Feet, 7 Inches, 5 Parts (because 6 is half 12) and set it a Place more to the right Hand; thus the half of 37 Feet, is 18; which I must count 18 Inches; because the Multiplier is 6 Parts; so the half of 37 Feet, 7 Inches, 5 Parts, is 1 Foot, 6 Inches, 9 Parts, 8 Seconds, 6 Thirds; which set down, and add all together, and the Sum will be 177 Feet, 1 Inch, 7 Parts, 0 Seconds 6 Thirds.

Example 3. Multiply 34 Feet 4 Inches, 7 Parts, by 36 Feet 7 Inches, 5 Parts.

F.	I.	P.	
34	: 4	: 7	
36	: 7	: 5	
<hr/>			
1866			
933			S.
103	: 9	: 6	: 4
77	: 10	: 1	: 9 T.
8	: 7	: 9	: 6 : 4
2	: 1	: 11	: 4 : 7
12	: 0	: 0	: 0 : 0
1	: 0	: 0	: 0 : 0
<hr/>			
11402	: 2	: 4	: 11 : 11

In this Example, because the Feet in both the Multiplicand and Multiplier are compound Numbers; first multiply the Feet one by the other; then take the Aliquot Parts of 7 Inches; which are 4 Inches and 3, that is, a third and a fourth Part; so take the third Part of 311 Feet, 4 Inches, 7 Parts, which is 103 Feet, 9 Inches, 6 Parts, 4 Seconds, and the fourth Part is 77 Feet, 10 Inches, 1 Part, 9 Seconds; set these down one under another, the Feet under the other Feet; then the Aliquot Parts of 5 Parts, are 4 and 1, that is a third and twelfth Part; so the third Part of 311 Feet, 4 Inches, 7 Parts, is 103 Feet, 9 Inches, 6 Parts, 4 Seconds; but because the Multiplier is Parts, it must be set a Place to the right Hand; that is, the 103 must be Inches, which is 8 Feet 7 Inches; therefore I take a fourth Part of 8 Feet 7 Inches; therefore I set down 8 Feet, 7 Inches, 9 Parts, 6 Se-

conds, 4 Thirds.

Then because 1 Inch is a fourth Part of 4 Inches, therefore take a fourth Part of 8 Feet, 7 Inches, 9 Parts, 6 Seconds, 4 Thirds; which is 2 Feet, 1 Inch, 11 Parts, 4 Seconds, 7 Thirds, which is the same as if you had taken a twelfth Part of 311 Feet, 4 Inches 7 Parts.

Then for 4 Inches in the Multiplicand, instead of multiplying 36 Feet by it, take a third Part, because 4 inches is a third Part of 12; so the third Part of 36, is 12 Feet, and the Aliquot Parts of 7 Parts, are 4 and 3, that is a fourth and a third; so the third Part of 36 is 12, which now is 12 Inches, that is 1 Foot, and the fourth Part is 9 Inches; add all these together, and the Sum will be 114½ Feet, 2 Inches, 4 Parts, 11 Seconds, 11 Thirds.

Example 4. Multiply 8 Feet 4 Inches, 3 Parts, 5 Seconds, 6 Thirds, by 3 Feet, 3 Inches, 7 Parts, 8 Seconds, 2 Thirds.

F.	I.	P.	S.	T				
8	:	4	:	3	:	5	:	6
3	:	3	:	7	:	8	:	2

25	:	0	:	10	:	4	:	6											
2	:	1	:	0	:	10	:	4	:	6									
		4	:	10	:	6	:	0	:	2	:	6							
				5	:	6	:	10	:	3	:	8	:	0					
						1	:	4	:	8	:	6	:	11	:	0			

27	:	7	:	3	:	5	:	1	:	8	:	8	:	11	:	0
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MUNIONS [in *Architecture*] are the short, upright Posts or Bars, which divide the several Lights in a Window Frame.

MURING is the Walling, or the raising of the Walls of a Building.

MUTILATION, is a Term apply'd to Statues and Buildings, where any Part is wanting, or the Projecture of any Member is broke off.

MUTULE [in *Architecture*] is a kind of square Modillion, set under the Cornice of the *Doric* Order, and so call'd from the Latin Word *Mutulus*, maimed, or imperfect, because they represent the Ends of Rafters which are crooked or bent, in like Manner as the Beams or Joints are represented by the Triglyphs in the Freeze of the same Order.

The only Difference between *Mutule* and *Modillion*, consists in this, that the former is us'd in speaking of the *Dorick* Order, and the latter in that of the *Corinthian*.

MUTULES, M. *LeClerc* makes *Mutules* in the Entablement of the *Doric* Order, to distinguish it the more from other Entablements; but also because they agree very well with the nobleness of this Order, and add something of a Masculine Beauty to it.

Those who use *Mutules*, usually make them of the same Breadth with the Triglyphs, but he thinks it would be much better, if they were made of the same Breadth with the Ca-

pitals of the Triglyphs.

Nor does he run his *Mutules* so near the Extremity of the Larmier or Drip, as is usually done; but that he leaves a Space of three or four Minutes between the two, that the Profile may appear the more distinctly, and he observes the same Rule in the *Modillions*.

N.

NAILS [in *Building &c.*] are small metalline Members, serving to bind or fasten the Parts together.

The several kinds of Nails are very numerous.

1. *Back and bottom Nails*; which are made with flat Shanks to hold fast, and not open the Wood, being proper for nailing of Boards together for Coolers, for Guts to save Water under the Eves of a House, or for any Liquid Vessels made of Planks or Boards.

2. *Clamp-Nails*; those proper to fasten the Clamps in Buildings, &c. and repairing of Ships.

3. *Clasp-Nails*; whose Heads clasping and sticking into the Wood, render the Work smooth, so as to admit a Plane over it, they are of two Kinds, *viz.* long, proper for fine Buildings of Fir and other soft Wood, and strong, fit for Oak, and other hard Wood; the Sizes are 7, 7½, 8, 10, 13, 15, 18, 21, 22, 23, 28, 32, 36, and 40 l. per Thousand.

Of the *Strong*, the Sizes are 15, 18, 28, 32, 40 l. per Thousand.

4. *Clench*

4. *Clench Nails* are those commonly us'd by Boat, Lighter- and Barge-Builders, with *Boves*, and often without, they are proper for any boarded Buildings that are to be taken, because they will drive without splitting the Wood, and draw without breaking; or admit of punching out, if rightly made. The Sorts are too many to be here enumerated; for fine Work they are made with *Clasp-Heads*.

5. *Clout-Nails*, these are ordinarily us'd for nailing on of Clouts to Axle-Trees, but are proper to fasten any Iron to Wood; and if made as they should be, the Heads will hold driving home, without flying.

The Sizes are $4\frac{1}{2}$, 7, 8, 9, 12 and 15 *l. per 1000*.

6. *Deck-Nails*, those are proper for fastening of Decks in Ships, doubling of Shipping, and Floors laid with Planks: They are of two Sorts, *Dye-headed*, and *Clasp-headed*.

The Sizes are 4, $4\frac{1}{2}$, 5, $5\frac{1}{4}$, 6, $6\frac{1}{2}$, 7, 8, and 9 Inches long.

7. *Dog-Nails*; proper for fastening Hinges on Doors, &c, if rightly made, they will hold the Hinge close, without the Heads flying off, or without the Help of Botching, by putting Leather between the Head and the Hinge.

The Sizes are 9, 12, 20, 25, 30, 40, 60, 80 and 120 *l. per Thousand*.

8. *Flat-Points*; are of two Kinds, *viz. Longs*, much us'd in Shipping, and are very proper where there is Occasion to draw and hold fast, where

there is no Conveniency to clench.

The Sizes are $7\frac{1}{2}$, 8, 9, 10, 11, 12, 13, 14, 16, 18, 21, 22, 23, 26, 40, 55, 75, and 110 *l. per Thousand*.

The *Short*, these are fortified with Points to drive into Oak or other hard Wood, and are often us'd to draw the Sheathing Boards to, very proper where Oak or other hard Wood is us'd,

The Sizes are 5, 9, 18, 26, 32, 40, 55, 75, and 110 *l. per Thousand*.

9. *Jobcut Nails*; these are commonly us'd to nail thin Plates of Iron to Wood; and to nail on small Hinges for Cupboard Doors, &c.

The Sizes are 2 and 3 *l. per Thousand*.

10. *Lead Nails*; are us'd in nailing Lead, Leather and Canvas to hard Wood.

The Sizes are $4\frac{1}{4}$, 7, and 8 *l. per Thousand*.

11. *Port Nails*; these are commonly us'd in nailing of Hinges to the Ports of Ships.

These Nails ought to be made strong, because they will not admit of being clenched, without prejudicing the Lining; and therefore you must take Care to demand them of a just Length, that they may come near through (so as to take sufficient Hold) and yet not so long as to come quite through.

The Sizes are $2\frac{1}{2}$, 3, 4 and 5 Inches long.

12. *Pound Nails*; these are four square in the Shank, much us'd in *Norfolk, Suffolk, and Essex*,

Essex, tho' scarce elsewhere; except for Paleing.

The Sizes are, 6*d.* 8*d.* 10*d.* 12*d.* and 40*d.*

13. *Ribbing Nails*; us'd for fastening the Ribbing, to keep the Ribs of Ships in their Place in Building.

These Nails, if they are rightly made, will hold fast and draw easy, without injuring the Ribbing or Timbers: They are also very useful for fastening of Timbers that are to be us'd for a while and taken down again for further Service.

The Sizes are 5, 5½, 6, 6½, 7, 7½, 8, 8½, and 9 Inches long.

14. *Rose Nails*; these Nails are drawn four Square on the Shank, and commonly in a round Tool, as all common 2*d.* Nails are, and most commonly 3*d.* and 4*d.*

In some Countries they make all their larger Sorts of Nails in this Shape; but their being Square drowneth the Iron, and the Nails do not shew so fair to the Eye, as those that are laid upon the flat, but they are very serviceable if made of tough Iron.

The Sizes are 1¾, 2, 2½, 2¾, 3, 3½, 3¾, 4, 4½, 4¾, 5, 9, 10, 13, 14, 16, 17, 18, 24, 26, 28, 30, 32, 36 and 40 *l.* per Thousand.

15. *Rother Nails* are chiefly us'd in fastening Rother Irons to Ships, these Nails require a full Head, and to be made so as to hold fast in the Wood to the greatest Degree, without clenching.

16. *Round-head Nails*; these

are very proper to fasten on Hinges, or for any other Use where a neat Head is requir'd; and if they are made of the best tough Iron as they ought to be, are very useful.

The Sorts are Tacks, 2*d.* 3*d.* 4*d.* 5*d.* 6*d.* and 8*d.*

The same are tinn'd for Coffin Handles and fine Hinges.

17. *Scupper Nails*, are much us'd in fastening Leather and Canvas to Wood, and therefore require a broad Head, that neither may work loose.

The Sizes are 4½, 7 and 8 *l.* per Thousand.

18. *Sharp Nails* are much us'd, especially in the *West-Indies*, they are made with sharp Points and flat Shanks, and is a very proper Nail for ordinary Uses where soft Wood is used.

The Sizes are 2½, 2¾, 3, 3½, 4, 4½, 5, 5½, 6, 6½, 7½, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 33, 28, 32, 36, 40, 55, and 75 *l.* per Thousand.

19. *Sheathing Nails*; these are commonly us'd in fastening Sheathing Boards to Ships: The Rule for using them is to have the Nails full three times as long as the Sheathing Board is thick; provided the Plank be of a sufficient Thickness, which ought to be enquired into; for the Sheathing Nail ought not to go through the Plank by half an Inch, lest it should make the Ship leaky.

The Shank must not be so strong as to cleave the Board, and the Head must be well clapsed or died, so as it may sink into the Wood, and the Ships Side be left smooth.

They

They are also a useful Nail in doubling of small Ships.

The Sizes are, $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2, $2\frac{1}{4}$, $2\frac{1}{2}$, $2\frac{3}{4}$, $3\frac{1}{4}$ and $3\frac{1}{2}$ Inches long.

20. *Square Nails*; these are of the same Shape as Sharp Nails, and a most useful Nail for Oak and other hard Woods, as also for nailing up Wall Fruit, the Points being made something stronger than the Points of Sharp Nails, which fortifies them to go forward, and not turn back upon a small Opposition, as weaker Points will do.

The Sizes are $2\frac{1}{2}$, $2\frac{3}{4}$, 3, 4, $4\frac{1}{2}$, 5, $5\frac{1}{2}$, 6, $6\frac{1}{2}$, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 22, 23, 24, 28, 30, 32, 36, 40, 55, and 75 *l. per* Thousand.

21. *Tacks*; the smallest of Nails, are to fasten Paper to Wood; *middling*, for Wool, Cards and Oars, and the *larger* for Upholsters and Pumps.

The Sizes are $2\frac{1}{4}$, 5, 6, 8, 9, 14 and 15 Ounces *per* Thousand.

Allowance in Lathing. 500 Nails are ordinarily allow'd to Bundle of five Foot Laths, and 600 to a Bundle of four Foot Laths; at six Score Nails to the Hundred.

Allowance in Flooring. In laying of Floors, 200 (that is 240) is a sufficient Allowance for a Square of Flooring.

Nails are said to be toughened when too brittle, by heating them in a Fire-Shovel or the like, and putting some Tallow or Grease among them.

NAKED [in *Architecture*] as the *Naked of a Wall*, &c.

is the Surface or Plain from whence the Projectures arise, or which serves as a Ground to the Projectures.

NAVE [in *Architecture*], the Body of a Church, or the Place where the People are dispos'd; reaching from the Rail or Balluster of the Choir, to the chief Door: Some derive it of *Naus i. e.* a Ship, but it seems more properly to come from *Nads Gr. Naos* a Temple.

NEWEL [in *Architecture*] is the upright Post which a Pair of winding Stairs turn about; or that Part of a Stair Case which sustains the Steps.

The Newel is a Cylinder of Wood or Stone, which bears on the Ground, and is form'd by the Ends of the Steps of the winding Stairs.

There are also Newels of Wood, which are Pieces of Wood plac'd perpendicularly, receiving the Tenants of the Steps of the wooden Stairs into their Mortices; and wherein are fitted the Shafts and Rests of the Stair Case, and the Flights of each Story.

NICHES are Hollows sunk into the Wall, for the commodious and agreeable placing of Statues.

Their ordinary Proportion is to have two Circles in Height and one in width; but *M. Le Clerc* makes their Height something more, the Excess being to compensate for the Height of the Plinth or Pedestal of the Statue.

The Hollow is Semi-Circular at Bottom, that is, in its Plan; at Top it terminates in

a kind of Canopy, or *Cul de four*.

Niches have frequently an Impost, and an Archivolte or Head Band, and their Canopy wrought and enrich'd in manner of a Shell.

The Breadth of the Archivolte may be made equal to a sixth or seventh Part of the Niche, and the Height of the Impost to be a fifth or sixth Part of the same.

The Impost and Archivolte ought to consist of such Mouldings as have some Relation to the Architecture of the Place.

When a *Niche* is placed underneath an Impost, between two Columns or Pilasters, it should have no Impost of its own; for two Imposts over each other, would have a woful Effect; besides that the Pedestals in this Case, having their Bases and Corniches, there would be too many Mouldings over one another.

There must no Niche be made between two Pilasters, if they are not a-part nearly one third of their Height; otherwise we should have Niches too scanty and narrow. Care must also be taken, that they be not too big; lest by that means the Architecture be made to appear little and pitiful: Thus, for Instance from the largeness of the Niche one is led to judge that the Architecture is only intended for a Chappel or other Building of an ordinary Size.

Niches should be plac'd at the Height of the Pedestal of the Columns or Pilasters that

accompany them.

When Niches are plac'd underneath Imposts, the opening of the Arches should be somewhat narrower than ordinary, that the Imposts being on that Account a little higher, the Niches may become of a moderate Bigness: For this Reason, instead of 12 Modillions between the Pilasters, M. *Le Clerc* says, I only make 11, that is, I retrench one Modillion from the Corniche, that the Pilasters may approach each other equally.

When the Columns have no Pedestals, a Niche may be rais'd higher than their Base; and in that Case, a Table or Pannel may be plac'd underneath:

If it happen that a Niche with an Impost be plac'd between two Pilasters, without any Portico, it should be made with a Retreat or Fall backwards, to prevent the Necessity of continuing its Impost between the Pilasters. For that Impost being proportioned to the Niche, cannot be in Proportion to the Pilasters. Besides, without this Expedient, I don't readily see how it could be well terminated on the Side of the Gate.

There are sometimes Niches made square, but these want all the Beauty of the others.

If the Order of the Column or Pilaster should be too big and high, the Niche would become too large and unsizeable, the Pilasters must be brought to a Modillion or two nearer each other, and instead of a Niche with a Retreat, a Niche

may be made with a *Chambrano*, and a Corniche crown'd with a Pediment, over which may be an oval Light of the same width with the Niche.

A *Round Niche* is one whose Plan and Circumference is circular.

Square Niche is one where they are square.

Angular Niche, one that is form'd in the Corner of a Building.

Ground Niche, is one which instead of bearing on a massive, has its Rise from the Ground, as the Niches of the Portico of the *Pantheon at Rome*.

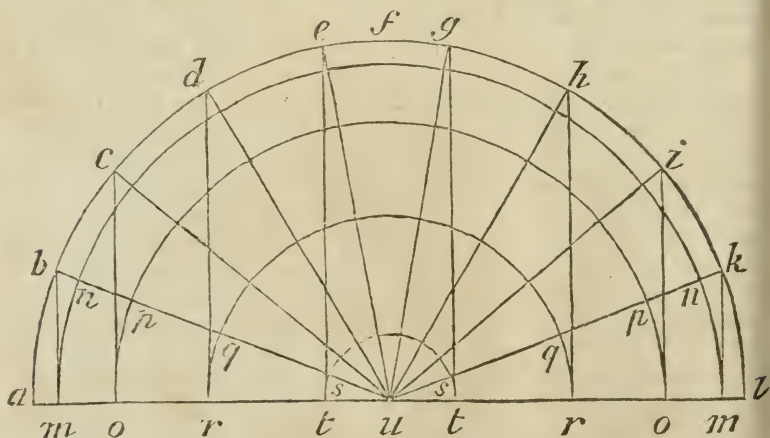
Niches are sometimes made with Rustick Work, sometimes with Shell Work, and sometimes of Cradle or Arbour Work.

If the Images be of white Stone or Marble, let not the

Concavities be coloured too black, because 'tis an Observation that the Sight is not well pleas'd with sudden Changes from one Extreme to another; therefore let them have rather a dusky Tincture, than an absolute black.

To make a Niche or Globe with thin Boards, or to cover them with Paper or Past-Board.

The Arch *a, f, l*, is a Semi-Circle, and the Plan of a *Niche*, and is divided into nine equal Parts mark'd, *a b, b c, c d, d e, e g, g h, h i, i k*, and *k l*; which represents the widest Part of the Board, Paper or Past-Board; and the Figure represents its Shape and the Curve of the Ridges before it is bent to its Work.

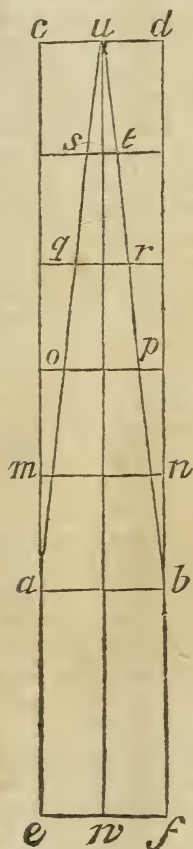


To do this, draw the Base Line *a l*, to which strike the Semi-Circle *a f l* (and let *a e*, and *f l*, be equal) and divide

it into so many Parts as you design the width of Board or Paper in the Quarter of the *Globe* or *Niche*, as in the Example Mark

Mark, $a b c d e f g h i k l$, and draw the Lines, $b u, c u, d u, e u, f u, g u, h u, i u$, and $k u$; also the Lines $m b, o c, r d, t e, t g, r h, o i$, and $m k$, perpendicular to the Line $a l$; and strike the Semi-circles $m m, o o, r r$, and $t t$,

Then with a thin Lath, or by Arithmetick take the Length of the Arch or Quadrant $a f$, or $l f$, and set it on the Board or Paper from $c d$, to $a b$, in the Second of these Figures, which you must divide into so



many equal Part as there are Semi-Circles in the first Figure, which in this Example is 5; and draw the Lines, $c d, t s, r q, o p, m n$, and $a b$ and divide them in the middle by the Line $u w$:

Then take half the Arch of the $a b$ in the first Figure in your Compasses, and set it both Ways from the middle Line $u w$ in the second Figure to a and b ; also take half the Circles $m n, o p, r q$, and $t s$, in the first Figure, and set them on their respective Lines on Figure 2, as in the Margin, from the middle Line $u w$, to m and n, o and p, r and q, t and s . then will the Arch $a b$, be equal to the Right Line $a b$; the Arch $m n$, to the Right Line $m n$; also $o p$ to $o p, r q$, to $r q, t s$, to $t s$, and the Point u to the Point u : The Points $a, m, o, q, s, u, t, r, p, n, b$, being found, into each stick a a Pin or small Nail, and bend a thin Lath to them, by the Edge of which draw the Curves $a u$, and $b u$, which is the true Mould for every Piece in a Niche or Globe; which is what was to be done.

N. B. This Problem is equally as useful for Masons and Bricklayers, in making Niches in Stone or Brick, as for Joiners, &c.

NOTATION [in *Arithmetick*] is the Art of characterizing Numbers, or of designing them by proper Figures, the Choice of arithmetical Characters is arbitrary: Hence they are various in various Nations. But perhaps there are none so

commodious, as those commonly us'd in *Europe*, which are commonly said to have been invented by the *Arabs*, and thence call'd *Arabick* Characters.

NUCLEUS [in *Architecture*] is the middle Part of the Flooring of the Ancients; consisting of Cement, which they put betwixt a Lay or Bed of Pebbles, cemented with Mortar made of Lime and Sand.

NUMBER [in *Arithmetick*] a Collection or Assemblage of several Unites.

Stevinus chuses to define Number to be that whereby the Quantity of any Thing is express'd. Agreeable to which Sir *Isaac Newton* conceives Number to consist, not in multitude of Unites, as *Euclid* defines it; but in the abstract Ratio of a Quantity of any Kind, to another Quantity of the same Kind, which is accounted as Unity; and on this View he divides Numbers into 3 Kinds, *viz. Integers, Fractions* and *Surds*.

Mathematicians considering Number under a great many Circumstances; different Relations and Accidents make many Kinds of Numbers.

A *determinate* **NUMBER**, is a Number referr'd to some given Unite; as a Ternary or 3, which is what we properly call a Number.

An *indeterminate* **NUMBER**, that referr'd to Unity in the General, which is what we call Unity.

Homogeneous **NUMBERS**, are those referr'd to the same Unite.

Heterogeneous **NUMBERS** are those referr'd to different ones.

Whole **NUMBERS**, or *Integers*, are the Assemblages of *Unity*, or the Idea we have of a Multitude.

Broken **NUMBERS** or *Fractions*, are those which consist of several Parts of *Unity*.

Rational **NUMBER**, is one that is commensurable with *Unity*.

Rational whole **NUMBER**, is that whereof *Unity* is an Aliquot Part.

Rational broken **NUMBER**, is that equal to some Aliquot Part, or Parts of *Unity*.

Rational mix'd **NUMBER**, is that which consists of a whole Number and a broken one, or of *Unity* and a Fraction.

Irrational **NUMBER** or *Surd*, is a Number that is incommensurable with *Unity*.

Even **NUMBER**, is that which may be divided into two equal Parts, or without Remainder or Fraction, as 4, 6, 8, 10, &c.

An *Evenly even* **NUMBER**, is one that may be measured or divided, without any Remainder, by another even Number.

Unevenly even **NUMBER**, is a Number that may be equally divided by an uneven Number, as 20 may be divided by 5.

Uneven **NUMBER**, is that which exceeds an even Number, at least by *Unity*, or which cannot be divided into two equal Parts.

Primitive or *Prime* **NUMBER**, is that which is only divisible by *Unity*, as 5, 7, 11, &c.

Prime

Prime NUMBERS among themselves, are those which have no common Measure, as 12 and 19.

Compound NUMBER, is one that is divisible by some other Number besides Unity, as 8 is divisible by 4 and by 2.

Compound NUMBERS among themselves, those which have some common Measure besides Unity, as 12 and 15.

Perfect NUMBER, is that whose Aliquot Parts added together, make the whole Number, as 6, 28, &c. the Aliquot Part of 6, being, 3, 2, and 1, = 6, and those of 28, being 14, 7, 4, 2, 1, which together make 28.

Imperfect NUMBERS, are those whose Aliquot Parts added together, make either more or less than the whole of which they are Parts.

Imperfect Numbers are distinguished into *abundant* and *defective*.

Abundant NUMBERS, are those whose Aliquot Parts, make more than the Number of which they are Parts, as 12, whose Aliquot Parts, 8, 4, 2 and 1, makes 16.

Defective NUMBERS, are those whose Aliquot Parts added together, make less than the Number whose Parts they are; as 16, whose Aliquot Parts are 8, 4, 2 and 1 only make 15.

Plane NUMBER, is one that arises from the Multiplication of two Numbers; *ex. gr.* 6 which is the Product of 3 multiply'd by 2; the Numbers which are thus multiply'd pro-

duce a *plane Number*, as here 2 and 6 are call'd the Sides of the *Plane*.

Square NUMBER, is the Product of any Number multiply'd by it self; Thus 4 the *Factum* of 2 by 2 is a square Number.

Every square Number added to its Root, makes an even Number.

Cubick NUMBER, is the Product of a *Square Number* multiply'd by its Root, *ex. gr.* 8 the Product of the Square Number 4, multiply'd by its Root 2.

Polygonous NUMBERS are the Sums of Arithmetical Progressions, beginning with Unity.

These where the Difference of Terms is 1. are call'd *Triangular Numbers*; where 2, *Square Numbers*; where 3, *Pentagonal Numbers*; where 4, *Hexagonal Numbers*; where 5, *Heptagonal Numbers*, &c.

Pyramidal NUMBERS, the Sums of *Polygonous Numbers*, collected after the same Manner as the *Polygons* themselves, are gathered out of Arithmetical Progressions, and are call'd *first Pyramidal Numbers*.

The Sums of the *first Pyramidals* are call'd *second Pyramidals*, the Sums of the *second Pyramidals* are call'd *third Pyramidals*.

In particular they are call'd *Triangular Pyramidal Numbers*, if they arise out of *Triangular Numbers* *first Pentagonal Numbers*, if they arise out of *Pentagonals*, &c.

Cardinal NUMBERS are those

those which express the Quantity of Unites as 1. 2. &c.

Ordinal NUMBERS, are those which express the Order or Rank, as 1st, 2^d, 3^d, &c.

NUMERATION, [in *Arithmetick*] the Art of valuing pronouncing, or reading any Number, or Series of Numbers.

The Characters by which Numbers are usually express'd, are the nine following ones, viz. 1, 2, 3, 4, 5, 6, 7, 8, 9. It being the Law of the common *Numeration*, that when you are arriv'd at ten, you begin again and repeat as before, only expressing the Number of tens.

That the nine numerical Notes may express not only Units, but also Tens or Decades, Hundreds or Centuries, Thousands, &c. They have a Local Value given them, so as that when either alone, or when plac'd in the Right Hand Place, they denote Units; in the second Place Tens; in the third Place, Hundreds, in the fourth, Thousands, &c.

NUMERATOR of a *Fraction*, is that Part of it which shews or numbers how many of those Parts which any Integer is suppos'd to be divided into, are express'd by the Fraction.

Thus in $\frac{3}{8}$ 6 is the Numerator (which stands always above the Line) and shews you, that if any whole be divided into eight Parts, you number and enumerate or take six of them, i. e. three Quarters.

O.

OAK, a Sort of Timber well known. It is one of the principal Materials in Building, being strong in all Positions, and may well be trusted in cross and transverse Work; as for Summers and Girding, or binding Beams, &c.

Of sawing Oak.] It is worth sawing 2s. 8d. per Hundred, 2s. and upwards to 3s. 6d. per Hundred, that is, a hundred superficial Feet.

OBELISK is a Quadrangular Pyramid, very high and slender, rais'd as an Ornament in some publick Place to shew the largeness of some Stone of an enormous Size, or to serve as a Monument of some memorable Transaction, and frequently charg'd with Inscriptions and Hieroglyphicks.

Some make this Distinction between *Obelisks* and *Pyramids*; that an *Obelisk* has a very small Base, and a *Pyramid* a large one.

Cardan makes the Difference to consist in this, that an *Obelisk* is to be all of a Piece, or consist of a single Stone and *Pyramids* of several.

The Proportions in the Height and Thickness, are nearly the same in all *Obelisks*, that is, their Height is nine or nine and a half, and sometimes ten times their Thickness, and their Thickness or Diameter at the Top is never less than half, and never greater than three fourth of that at the Bottom.

It

It appears that this Kind of Monument was very ancient, and some say, they were first us'd for transmitting to Posterity the principal Precepts of Philosophy, which were engraven on them in Hieroglyphical Characters. The first *Obelisk*, History gives us Account of, was rais'd by *Ramises* King of *Egypt*, in the Time of the Trojan War. It was 40 Cubits in Height, and as *Herodorus* relates, employ'd 20000 Men in the Building.

Another of 45 high, was rais'd by *Phius* another King of *Egypt*, and another of 88 Cubits, was erected in Memory of *Arsinoe*, by *Ptolemy Philadelphus*.

There was an *Obelisk* erect in the *Campus Martius* at *Rome* by *Augustus Caesar*, which serv'd to mark the Hours on a horizontal Dial, drawn on the Pavement.

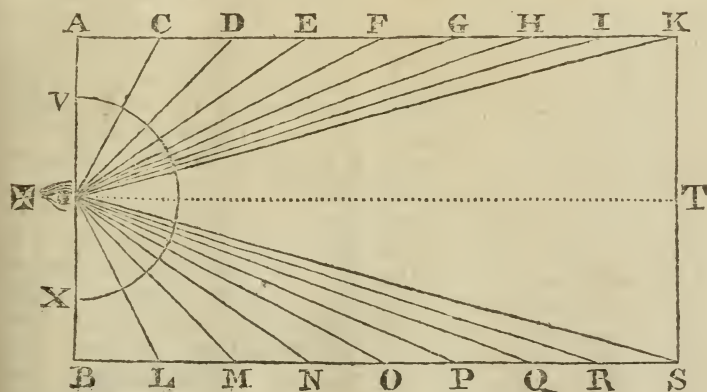
F. Kircher reckons up 14 *Obelisks* that were celebrated above the Rest, viz. that of

Alexandria; that of the *Barberins*; those of *Constantinople*; of the *Mons Esquilinus*; of the *Campus Flaminius*; of *Florence*; of *Heliopolis*; of *Ludovisco*; of *S. Makut*; of the *Medici*, of the *Vatican*: of *M. Celius*, and that of *Pamphila*.

Obelisks were called the Sun's Fingers by the *Egyptian Priests*, because they were made to serve as *Styles*, or *Gnomons* to mark the Hours on the Ground. The *Arabs* still call them *Pharaoh's Needles*, whence the *Italians* call them *Argullia*, and the *French* *Aiguillies*.

OBJECTS [in *Perspective*] It is shewn by the following Figure why Objects appear the nearer each other, as they are more remote from the Eye.

Suppose a Spectators Eye in the middle of a Line at + it is evident, that if it would see the two Extremes thereof, A and B, it must take, in a Semi-Circle V X, whose Centre is in the Eye it self, and whose central Ray, is the Line + T.



By taking in this Semi-Circle, it will receive the Objects on either Side, and in such Manner, as that those furthest off from the Side A, appear to approach towards the Centre T, and those on the Side B, seem to approach likewise.

Now if it be ask'd, How Things so wide asunder, should come to approach and join each other, and that, whether situated Side-wise, or over one another?

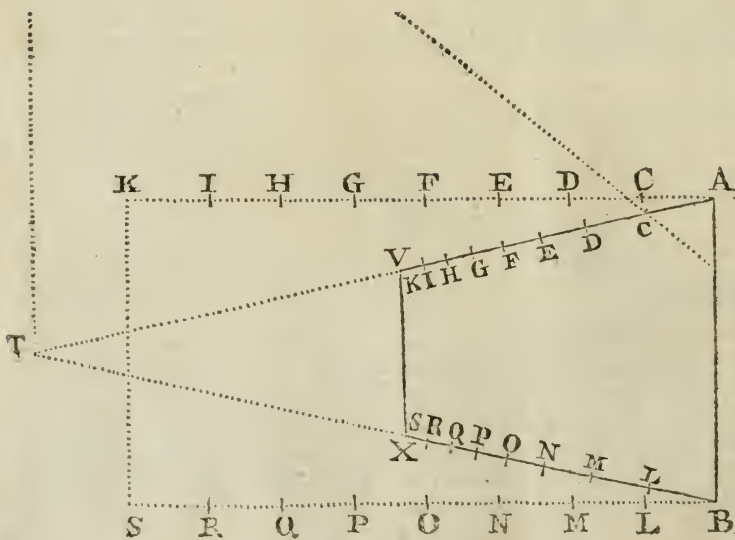
The Answer in few Words, is this: All Objects appear under the visual Angle, they subtend at the Eye. Now be they Columns, Trees, Animals or any other Things, plac'd on the Side of A, the Remotest will seem to border on the Centre T, by Reason that they are seen under an Angle or Ray that is near thereto.

The Ray + K for Instance, being much nearer the Central

Ray T, than is the Ray + C and + E, and of Consequence must appear to be there: Add that if the Objects were prolonged to Infinity, they would still approach nearer to the Central Ray T. till such Time as they seem contiguous therewith, and only to form one Point together.

Now in Perspective, the Sides A K and B S don't continue parallel, but degenerate into visual Rays, intersecting each other in the Point of Sight, and by that means giving the Diminution of Objects.

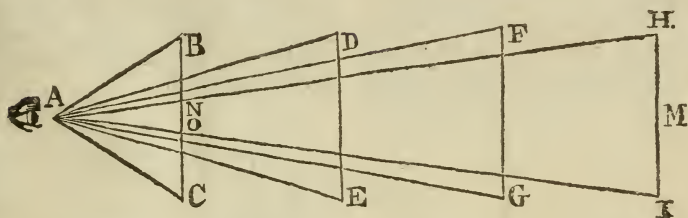
Thus for Instance, in this Figure, the Eye being at a Distance capable of seeing the Line A B, from the two Angles A B arise two Rays, which proceed to the Point of Sight T, which Rays A T and B T receive the Intersections, the Point of Distance makes with the Objects, which all the



while contract themselves proportionably. By such Means, the whole Parallelogram A K B S, and all the Objects on either Side become reduc'd into the narrow Compass A V B X; and if the Eye were more remote, that Space would be still smaller; since the farther an Object is off, the smaller it appears, as will appear by the following Figure.

The Reason why Objects appear the smaller, as they are at the greater Distance.

It has been shewn before that Things appear according to the Angle wherein they are seen, and that this Angle is taken at the Eye, where the Lines terminating the Objects meet.



The Eye A for Instance, viewing the Object B C, will draw the Rays A B and A C, which give the Angle B A C; so that an Object view'd under a greater Angle, will appear large, and another under a lesser Angle, little.

Now 'tis certain, that among equal Objects, those at the greatest Distance, will appear under the smallest Angle; consequently in all Perspectives, the remotest Objects must be made the smallest.

As for Example, if the Eye be in A, the Object B C, which is the nearest, will appear the biggest, because being seen under the greatest Angle; and the second, third fourth Objects, will all appear smaller and smaller, tho' really all equal, in as much as the Angles diminish in Proportion as

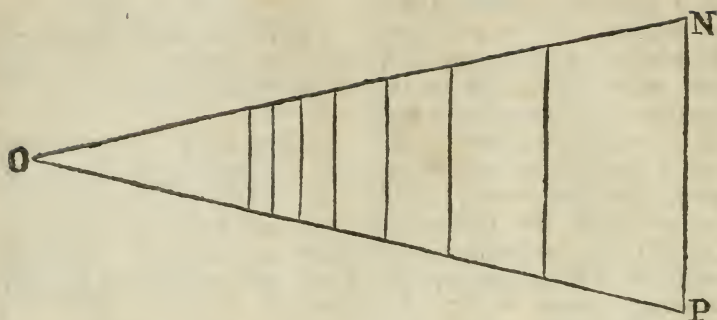
the Objects recede.

If the Eye were remov'd into M K L, would appear the largest; and B C in this latter Case, no bigger than N O.

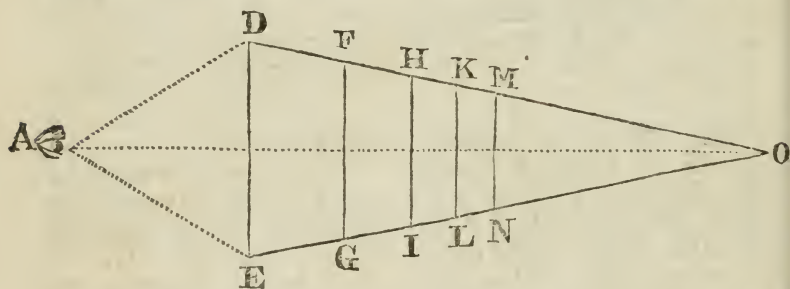
The Second Figure is the Sequel of what has been advanc'd.

For supposing the Objects to appear such as is the Angle they are seen in, it follows that if several Lines be drawn between the Sides of the same Triangle, they will all appear equal: Thus all the Lines compriz'd between the Sides O N O P of the Triangle N O P, will appear equal to each other; and as Objects comprehended under the same Angle, seem equal, so all comprehended under a greater Angle seem greater, and all under a smaller Angle, smaller.

Thus



Thus much being suppos'd ; of Necessity be all made under if there be a Number of Columns or Pilasters to be rang'd towards one common Point in Perspective on each Side of the Horizon O. a Hall or Church, they must



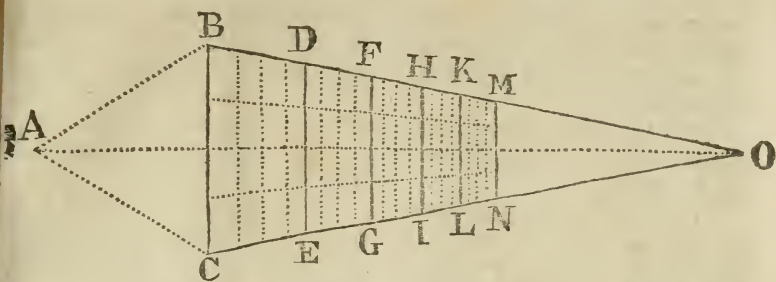
For Instance, the Eye being plac'd in A, viewing the first Object D E ; if from the Point D E you draw the visual Rays D O, E O, they will make the Triangle D O E, which will include the Columns D E, F G, H I, K L, M N, so as they will all appear equal.

What has been said of the Sides is likewise to be understood of Ceilings and Pavements ; the Diminutions of the Angles of remote Objects, plac'd either above or below, following the same Rule as those plac'd laterally.

Therefore there is no need

of adding any thing farther ; unless it be, that Care be taken that there be as many Squares or Divisions between the remotest Objects, as between the nearest : for in that Case, tho' distant Objects be the closer, as they are further from us, they will appear in some Measure to preserve their Distance ; thus in B C D E, the Interval between the four nearest Columns, there are 16 Squares ; and no fewer between the two most remotest K M.

It follows from what has been said, that if you join two Triangles, as in the last Figure but



one for the Sides, and two others of the last, for Tops and Bottoms of an Object, all four will terminate in one single Point A, which is the Point of Sight where all visual Rays meet; and this will demonstrate what has been advanc'd, *viz.* that Objects diminish as they remove, the lower rising, the upper falling, and the lateral closing or approaching: an Example of all which is given in Figure 1, which exhibits as it were, Depths and Distances, falling back and receding from us, though all equally near the Eye.

Trees being rang'd by the same Law, have the same Effect as the Columns, &c.

For being all comprehended in the same Angle, and the two Rows having each its own Angle, and the Angles all meeting in the Point A, they form a third, which is the Earth and a fourth, which if you please is the Air.

OBLIQUATION [in *Catoptricks*] as the Cathetus of Obliquation is a Right Line drawn perpendicular to a Mirror in the Point of Incidence or Reflexion of a Ray.

OBLIQUE [in *Geometry*]

asslant, Indirect, or which deviates from the Perpendicular.

OBLIQUE Angle [in *Geometry*] is an Angle that is either acute or obtuse: *i. e.* any Angle, except a Right Angle.

OBLIQUE angled Triangle, is that whose Angles are oblique, *i. e.* either obtuse or acute.

OBLIQUE Line, a Line falling on another, makes an oblique Angle.

OBLIQUE Projection [in *Mechanicks*] is that where a Body is impell'd in a Line of Direction, which makes an oblique Angle with the horizontal Line.

OBLIQUE Force [in *Mechanicks*] is that whose Line of Direction is not at Right Angles with the Body on whom it is impress'd. The Ratio which such an *oblique Force* to move a Body bears to a direct or Perpendicular Force, will be as the Line of the Angle of Incidence is to the Radius.

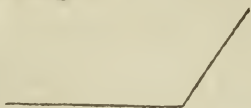
OBLIQUITY is that which denominates a Thing oblique, as the Obliquity of the Sphere.

OBLONG [in *Geometry*] is the same with a Rectangled Parallelogram, whose Sides are unequal; or it is a Figure longer

longer than it is broad; thus a Rectangle or Parallelogram is an oblong; and an Ellipsis in an Oblong.

OBTUSE, literally signifies blunt, dull; in Opposition to acute, sharp.

OBTUSE Angle [in Geometry] is an Angle of more than 90 Degrees, *i. e.* more than a Quadrant of a Circle; or it is an Angle greater than a Right Angle.



OBTUSE angled Triangle is one that hath an obtuse Angle, as above.

OCCULT [in Geometry] is us'd in speaking of a Line that is scarce perceivable, drawn with the Point of the Compasses or a black Lead Pencil.

Occult or dry Lines are us'd on several Operations, as the raising of Plans, Designs of Building, Pieces of Perspective &c. they are to be effaced when the Work is finish'd.

OCTAGON [in Geometry] is a Figure of eight Sides and Angles; or it is one of the



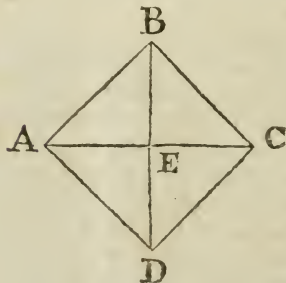
five Regular Bodies, consisting of eight equal Faces, or eight equilateral Triangles. It is call'd a *regular Octagon*, when all the Sides and Angles are equal, and is such as may be inscrib'd in a Circle.

Every *Regular Octagon* is a mean Proportional between the circumscribing and the inscrib'd Square.

OCTAHEDRON } [in Geo-
OCTAEDRON } metry]
is one of the Regular Solids, consisting of eight equal and equilateral Triangles.

The Square of the Side of the *Octahedron* is to the Square of the Diameter of the circumscribing Sphere, as 1 to 2 or is in a Subduple Ratio of the Diameter of the circumscribing Sphere.

If the Diameter of the Sphere be 1. the Solidity of the *Octahedron* inscrib'd to it, will be 1.33333.



Let A B C D E be an *Octahedron*, whose Side is 12 Inches; the Content Solid and Superficial is requir'd.

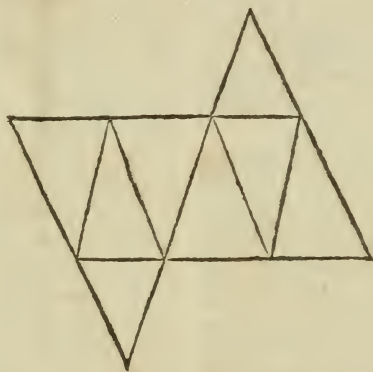
An *Octahedron* is compos'd of two Quadrangular Pyramids join'd together by their Bases, as in the second Figure; therefore

fore if the Area of the Base be multiply'd into a third Part of the Length of both Pyramids, the Product will be the Solid Content.

$$\begin{array}{r}
 5.6568 \\
 \underline{144} \\
 226272 \\
 226272 \\
 \underline{56568} \\
 \hline
 814.5792
 \end{array}$$

The Superficial Content will be just double to that of the *Tetrahedron*, viz. 498.816; because the Side of this is suppos'd to be equal to the Side of that; and because the *Octahedron* is contain'd under 8 Triangles and the *Tetrahedron* but under 4.

By this Figure you may cut this Body in fine Paste-board, cutting all the Lines half through, and so turn it up and glue it.



OCTOSTYLE [in *Architecture*] is the Face of an Edifice adorn'd with 8 Columns.

OFFICES [in *Architecture*] are all the Lodges and Apartments, which are employ'd for the necessary Services and Occasions of a Palace or great House; especially those which have Relation to Eating; as, Kitchens, Pantries, Bake-Houses, Brew-Houses, Granaries, Fruiteries, Confectionaries, Wood-Houses, Equeries, &c.

The Offices are commonly in the Back Courts; and sometimes they are sunk under

Ground, and well vaulted, &c.

OGEE } [in *Architecture*]
O. G } is a Moulding
OGIVE } consisting of 2 Members, the one Concave and the other Convex, or of a round and a hollow, like an S, the same with *Cymatium*.

Vitruvius makes each Member a Quadrant of a Circle. *Scamozzi* and some Others, make them somewhat flatter, and strike them from two equilateral Triangles.

OGIVE [in *Architecture*] Is us'd for an Arch or a Branch of a *Gothick* Vault, which instead

stead of being circular, passes diagonally from one Angle to another, and forms a Cross between the other Arches, which makes the Sides of the Square, of which the Arches are Diagonals.

The middle where the *Ogives* cut or cross each other, is call'd the Key; which is sometimes cut in form of a Rose, or a *Cul de Lamp*.

The Members or Mouldings of the *Ogives* are call'd Nerves, Branches, or Reins; and the Arches which separate the *Ogives*, double Arches.

OIL: To make a drying Oil to make any Colour that is mixt with it, dry quickly,

Add two Ounces of Litharge of Lead (to be had at the Druggists) to a Quart of Linseed Oil (tho' some use Red Lead) powdered very fine, and boil it for near an Hour in an earthen Pan, or till the Oil be grown fat, or almost of the Consistence of Treacle, then set it on Fire with a lighted Paper, keep it stirring while burning, which need not be above a Minute or two, then put out the Flame, and let it stand till it be thoroughly cold, and that the Litharge has settled well to the Bottom; then pour off the clear Oil, and put it in a Bladder, close ty'd up for Use.

When you mix up your Colours for working, take three Parts of plain Linseed Oil, and one Part of this drying Oil and mixing them well together, temper up your Colours with this Mixture.

This fat drying Oil shall not only make the Colours dry sooner; but will also add a Beauty and Lustre to the Colours.

Some Colours indeed don't need to have their Drying hasten'd by a fat Oil, as Red-Lead, Verdigrease and Umber, they being very drying of their own Nature; but yet fat Oil added to those also, add a great Beauty and Lustre to their Colour.

Some Painters to make their Colour dry, take *Copperas*, and having beaten it to Powder, burn it in a Fire-Shovel; as People do when they burn Allum, that is, they set it on a Fire, till being melted with the Heat, it be continued thereon so long, till all the Moisture be exhaled, and the Matter remain a dry white Calx; some of this Powder of burnt *Copperas* being added to the Colours in Grinding, will make the Colour dry very well.

There is indeed one Inconvenience in the drying Oil above-mentioned, which is, that it makes the Oil of a deep reddish Colour, which is apt to alter the native Beauty of some Colours, as Whites, making them turn Yellow, and blues become Greenish.

But a drying Oil may be prepar'd, which shall be of a clear white Colour, as follows.

Put two Ounces of Litharge to a Quart of Linseed Oil, put the Mixture into a Glass, and set it in the hot Sun for a Month in the Summer time; stirring the

the Litharge and the Oil well together twice a Week during the whole Time; and you will not fail in that time to have not only an Oil very white and clear (for the Sun takes away all Colour either from Linseed or Walnut Oil) but also it will become in that Time very fat and thick, and attain a very drying Quality.

By the same Methods may Nut Oil be made to dry, as well as that of Linseed, it being preferr'd before that of Linseed, for all white Painting that is not expos'd to the open Air, for 'tis observ'd, that in all close Places, Linseed Oil is apt to make white Lead turn yellow.

You must take Notice that all simple Colours us'd in House Painting, appear much more beautiful and lustrous when they appear as if glaz'd over with a Varnish, to which both the drying Oil mentioned before, contributes very much, and also the Oil of Turpentine, that Painters use to make their Colours dry soon.

But Experience has taught, that some good clear Turpentine, dissolv'd in the 'foresaid Oil of Turpentine, before it be mix'd with the Oil Colours, will make those Colours shine much when dry, and preserve their Beauty beyond most other Things, drying with an extreme Glossy Surface, more smooth than Oil alone, and will also better resist the Injuries of the Air and Weather, provided too much of it be not put in.

OMPHALOPTICK [in *Opticks*] is a Glass that is convex usually call'd a *Convex Lens*.

OPPOSITION [in *Geometry*] is the Relation of two Things between which a Line may be drawn Perpendicular.

OPTICKS is properly the Science of direct Vision; tho' the Word is sometimes us'd in a larger Sense, for the Science of Vision or Visibles in general; and in this Sense it includes *Catoptricks*, *Dioptricks*, and even *Perspective*.

Opticks is a mathematical Science that treats of the *Sight* in general, and of every thing which is seen with direct Rays; and explains the several Properties and Effects of Vision in general, and properly of that which is direct and ordinary; for when the Rays of Light are considered as *reflected*, the Science which teaches their Laws and Properties is call'd *Catoptricks*; and when the *Refraction* of Rays is consider'd, and the Laws and Nature of it explain'd and demonstrated, the Science is call'd *Dioptricks*; or

Opticks in its extensive Signification may be consider'd as a mixt mathematical Science, explaining the Manner wherein Vision is perform'd in the Eye; treats of the Sight in the general; gives the Reason of the several Modifications or Alterations which the Rays of Light undergo in the Eye, and why Objects appear sometimes bigger and sometimes smaller, sometimes more distinct, sometimes more confus'd, sometimes nearer

nearer and sometimes farther off.

In this extensive Signification it is consider'd by Sir *Isaac Newton* in his admirable Work call'd *Opticks*; from *Opticks* likewise arises *Perspective*; all the Rules of which have their Reason or Foundation in *Opticks*; and though *Tacquet* makes *Perspective* a Part of *Opticks*, yet *John* Archbishop of *Canterbury*, calls *Opticks*, *Catoptricks* and *Dioptricks*, by the Name of *Perspective*.

OPTICK Pencil or Pencil of Rays, is that Assemblage of Rays, by Means whereof any Point or Part of an Object is seen.

OPTICK Pyramid [in *Perspective*] is a Pyramid, whose Base is the visible Object, and its Vertex in the Eye; form'd by Rays drawn from the several Points of the Perimeter.

OPTICK Rays are particularly us'd for those wherewith an *Optick Pyramid* or *Optick Triangle* is terminated, as

OPTICK Axis, is a Ray passing through the Centre or the middle of the *Optick Pyramid*.

OPTICK Chamber; or call'd **CAMERA OBSCURA**, is the Name of an Optick Machine; wherein (the Light only coming through a double Convex Glass) Objects expos'd to broad Day-Light, and opposite to the Glass, are represented inverted upon any white Matter placed within the Machine in the Focus of the Glass.

The Representations of Ob-

jects in this Machine are wonderfully pleasant, not only because they appear in their just Proportions, and are endued with all the natural Colour of their Objects; but likewise shew their various Motions, which no Art can imitate; and a skilful Painter by the Assistance of one of these Machines, may observe many Things from the Contemplation of the Appearance of Objects therein, which will be an Help to the Perfection of the Art of *Painting*, and even a Bungler may accurately enough delineate Objects by Means of it.

Mr. Gravesend at the End of his *Perspective* has given the Description and Use of two Machines of this Kind, which are the best that have yet been made. especially the former.

OPTICK Glasses, are Glasses that are ground either Concave or Convex, so as either to collect or disperse the Rays of Light; by Means of which, Vision is improv'd, and the Eye strengthened, preserv'd, &c.

ORATORY [in *Architecture*] is a Closet or little Apartment in a large House near a Bed Chamber, furnish'd with a little Altar, or an Image for private Devotion (among the *Romanists*).

The ancient Oratories were little Chappels adjoining to Monasteries, where the Monks said their Prayers before they had Churches.

ORDER [in *Architecture*] is a System of the several Members,

Members, Ornaments and Proportions of Columns and Pillars; or it is a regular Arrangement of the projecting Parts of a Building, especially those of a Column; so as to form one beautiful whole: Or *Order* is a certain Rule for the Proportions of Columns, and for the Figures which some of the Parts ought to have, on the Account of the Proportions that are given them.

M. *Le Clerc* defines an *Order* to be a Column charg'd with an *Entablature*, and supported on a Pedestal.

The Origin of Orders may be said to be almost as ancient as human Society: the Rigour of the Seasons first put Men upon making little Cabins to retire into; at the first they were made half under Ground, and half above, and were covered with Stubble. But in Time growing more expert, they laid Trunks of Trees an End, and laid others a-crofs to bear up the Covering.

From hence they took the Hint of more regular Architecture; the Trunks of Trees upright, representing Columns; and the Girds or Bands which serv'd to keep the Trunks from bursting, express'd Bases and Capitals; and the Summers which lay a-crofs, gave the Hint of Entablatures; and likewise did the Coverings ending in Points, give a Notion of Pediments. This Hypothesis we have from *Vitruvius*, and it has been well illustrated by M. *Blondel*.

Others are of the Opinion that Columns took their Rise

from the Pyramids which were erected by the Ancients over Tombs; and that the Urns wherein their Ashes were inclos'd, represented the Capitals, the *Abacus* of which was a Brick laid over to cover the Urn: But *Vitruvius's* Account seems the most natural.

In time, the Height of Columns were regulated by the *Greeks* on the Foot of the Proportion of a human Body. The *Doric* represented a Man of a strong, robust make; the *Ionic* that of a Woman, and the *Corinthian* that of a Girl; Their Bases and Capitals were their Shoes, Head Drets, &c.

The three *Greek* Orders represent three different Manners of Building, *viz.* the *solid*, *mean*, and *delicate*; the two *Italian* ones, are imperfect Productions of these.

The little Regard the *Romans* had for these last, appears from this, that we meet not with one Instance in the *Antique* where they are intermixt.

Daviler observes, that the Abuse the Moderns have introduc'd by the Mixture of the *Greek* and *Latin* Orders, arises from their Want of Reflection on the Use which the Ancients made thereof.

The Definitions *Vitruvius*, *Barbaro*, and *Scamozzi*, have given of Orders, are so obscure, that it is not worth while to spend Time in repeating them; it is sufficient to observe, that there are five Orders of Columns; three of which are *Greek*, *viz.* the *Doric*, *Ionic*, and

and *Corinthian*; and two *Italian*, viz. the *Tuscan* and *Composite*.

To give a general Idea of the *Orders*, it will be necessary to observe, that the whole is compos'd of two Parts at least, viz. the Column and the Entablature, and of four Parts; at the most; where there is a *Pedestal* under the Columns; and one *Acroter* or little Pedestal on the Top of the Entablature.

That the Column has three Parts, viz. the *Base*, the *Shaft* and the *Capital*; the *Entablature* has three likewise, viz. the *Architrave*, the *Frize* and the *Cornice*; which Parts are all different in the several Orders, having each their particular Characters and Members, call'd by the general Names of *Mouldings* or *Ornaments*.

These Orders took their Names from the People among whom they were invented. *Scammozzi* calls the *Tuscan* the *Gigantick*; the *Doric*, the *Herculean*; the *Ionic*, the *Matronal*; the *Composite*, the *Heroick*, and the *Corinthian* the *Virginal*.

I shall here present you with what M. *Le Clerc* gives us, relating to the Orders.

An Order of Columns is usually understood of a Column bearing its Entablature; but the Order is scarcely compleat except the Column be rais'd on a Pedestal.

The Pedestal, Column and Entablement, are three Compound Parts, each consisting of three Others, as has been said before.

The Ancients have given us five several Orders of Columns, the *Tuscan*, *Doric*, *Ionic*, *Roman* and *Corinthian*.

The *Tuscan* ORDER is the first, most simple and solid, its Column is seven Diameters high, and its Capital, Base and Entablature, have but few Mouldings for Ornaments.

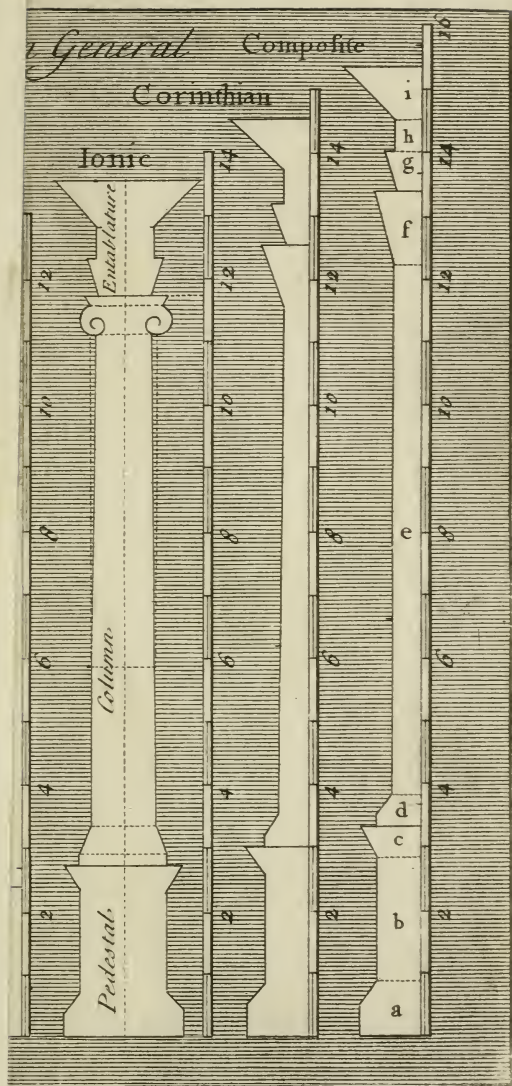
If we give Credit to M. *de Cambray* in his Parallel, this Order ought never to be us'd any where but in Rusticks, or Country Houses and Places.

And indeed, in the Manner that *Vitruvius*, *Palladio*, and some others describe it, it scarce deserves to be us'd at all.

Methinks however in *Vignola's* Manner of Composition, it has certain Beauties in its Simplicity, which add a Value to it, and render it worthy to be us'd, not only in private Houses, but also in publick Buildings; as in Porticoes of Markets; of publick Halls; in Magazines or Granaries of Cities; and even in Palaces and Seats of Princes and Noblemen, particularly in the lower Apartments, Offices, Stables, (not Equerries as is translated there) &c.

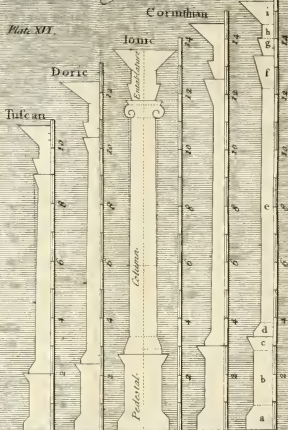
And in general, in all Places, where Strength and Simplicity are required, and where any of the richer and more delicate Orders would be unsuitable.

The *Doric* ORDER is the Second, and most agreeable to Nature. It is the most ancient, and given us by the *Greeks*; It has no Ornament on its Base, or on its Capital. Its Height



The Orders in General Composite

Plate XII.



s eight Diameters. Its Frieze is distinguish'd by Triglyphs and Metopes.

Its Composition is grand and noble, and the Triglyphs which make the Ornaments of its Frieze, bearing some Resemblance to a Lyre, seems to intimate it to have been originally intended for some Temple consecrated to *Apollo*.

As we are now furnish'd with richer and more delicate Ornaments, the *Doric* is most properly us'd in the Gates of Cities, in Arsenals and Places of Arms; in Halls of Guards, and other Buildings, which have Relation to War; where Strength and a rough, but noble Simplicity, are particularly requir'd.

In the most ancient Monuments of this *Order*, the Columns are without Bases, the Reason of which is not easy to assign.

M. de Cambray in his *Parallele*, is of the same Opinion with *Vitruvius*, that the *Doric* Column, not the *Ionic*, (as the Translator of *Le Clerc* has it) having been compos'd in Imitation of a naked Man, nervous and robust, as an Hercules, it ought to have no Base; imagining a Base to be that to a Column, which a Shoe is to a Man. But for my own Part, I must confess, I can't consider a Column without a Base, but in comparing it to a Man; I rather form the Idea of a Man without Feet, than without shoes.

For this Reason, I am rather of Opinion, either that the an-

cient Architects had not yet thought of adding Bases to their Columns, or that they declin'd, on Purpose, to give them any, with design to keep the Pavement clear, and unembarrass'd with the Angles and Projectures of Bases, which are apt to occasion People passing by to stumble.

This also appears the more probable, in Regard that the Architects of those Times us'd to range their Columns exceedingly near one another; so that if they had been furnish'd with Bases, the Passages between, would have been extremely narrow and incommodious.

And this appears to be the Reason, why *Vitruvius* orders the Plinth of the *Tuscan* Column to be rounded off; that Order in the Manner he describes it, being particularly adapted to the servile Offices of Business, and Commerce, where Conveniency is always to be consulted before Beauty.

Be this as it will, every Man of a good Taste will allow, that a Base adds a Grace to a Column, and that it is a very necessary Appendage, in Regard it makes it stand the more firmly on its Plan: so that if no Columns are made now without Bases, this ought not to be imputed to the Prejudices of our Architects, as some Admirers of Antiquity will have it; but to their Prudence.

The *Ionic* ORDER is the third, and a kind of mean Proportional between the solid and delicate Manner. Its Capital

its adorn'd with Volutes, and its Cornice with Denticles.

Michael Angelo, contrary to all other Authors, gives the *Ionic* a single Row of Leaves, at the Bottom of the Capital.

The first Idea of this Order was given by the *Ionians*, who according to *Vitruvius*, compos'd this Column on the Model of a young Lady, dressing in her Hair, of an easy and delicate Shape; as the *Doric* had been form'd on the Model of a strong robust Man.

It is said, the Temple of *Diana* at *Ephesus*, the most celebrated Edifice of all Antiquity, was of this Order.

It may now be us'd in Buildings of Piety, as in Churches, Courts of Justice, in Apartments of Ladies, and in other Places of Quietude and Peace.

The *Corinthian* ORDER invented by *Calimachus*, is the fourth, the richest and the most delicate. Its Capital is adorn'd with two Rows of Leaves, and eight Volutes, which sustain the *Abacus*. Its Column is ten Diameters high, and its Cornice has Modillions.

This is indeed a Master Piece of Art, for which we are indebted to the City of *Corinth*. It ought always to be us'd in most stately and most magnificent Buildings.

The *Composite* or *Roman* ORDER, is the fifth and last (tho' *Scammozzi* makes it the fourth). It is call'd the *Composite*, because its Capital is compos'd out of those of the other Orders; having two Rows of Leaves of the *Corinthian*, and

the Volutes of the *Ionic*. It is also call'd the *Roman*, because invented among that People. Its Column is ten Diameters high; and its Corniche has Denticles or simple Modillions.

This Column has also a Quarter Round as the *Tuscan* and *Doric*. Most of our Architects in Compliance with Usage and Custom, place this after the *Corinthian*; doubtless because it was the last that was invented. *Scammozzi* is the only Author who varies from the Rule, but he does it with so much Judgment, that we scruple not to imitate him.

This Order may be us'd in every Place, and on every Occasion, where 'tis requir'd that Strength, Richness and Beauty should be found together.

Rustick ORDER is that adorn'd with Rustick Quoins, Boscages, &c.

Attick ORDER is a little Order of low Pilasters, with an architrav'd Corniche for its Entablature, as that of the Castle of *Versailles*, over the *Jonie*, on the Side of the Garden.

M. Blondel calls the little Pilasters of *Atticks* and *Mexzarines*, false Orders.

Persian ORDER is that which has Figures of *Persian* Slaves, instead of Columns to support the Entablature.

Caryatick ORDER, is that whose Entablature is supported with Figures of Women instead of Columns.

Gothic ORDER, is an Order which deviates from the Ornaments and Proportions of the Antique; and whose Columns

lums are either too massive, in Manner of Pillars; or too slender, like Poles; its Capitals out off all Measure; and carv'd with Leaves of wild *Acanthus*, Thistles, Cabbage, or the like.

French ORDER, is a new contriv'd *Order*, wherein the Capitals consist of Attributes agreeing to that People, as Cock's Heads, Flower de Lys, &c.

The Proportions of this *Order* are *Corinthian*. Such is that of *M. Le Brun*, in the grand Gallery of *Versailles*, and that of *M. Le Clerc*.

M. Le Clerc gives a second *Tuscan Order*, and a *Spanish Order*, besides his *French Order*. The *Tuscan* he ranks between the first *Tuscan* and *Doric*. He makes the Height of it 23 Semi-Diameters, 22 Minutes; the Columns to have 15, the Pedestal 5, and the Entablature 3 and 22 Minutes, and he proposes its Frieze to be adorn'd with Turtles; which are the Arms of *Tuscany*.

He places the *Spanish Order* between the *Corinthian* and *Composite*. He makes the whole *Order* 30 Semi-Diameters, 28 Minutes; the Column of which has 19 and 25 Minutes, the Pedestal 16, and 18 Minutes, and the Entablature, 4 and 15 Minutes.

The Horns of the *Abacus* he sustains with little Volutes; the middle, in Lieu of a Rose, has a Lion's Snout; that Animal being the Symbol of *Spain*, and expressing the Strength, Gravity and Prudence of that Nation.

These several *Orders*, says *M. Le Clerc*, speaking of the five first, have been very judiciously compos'd at various Times, in order to suit the various kinds of Buildings, which either Necessity or Magnificence should occasion Men to erect, and these are ever made more or less simple, each in its Kind; and more or less slender, according to the Buildings they are us'd in, and the Riches of the Princes, People, or private Persons who build them.

M. Le Clerc treats of the different Manners wherein the five *Orders* or Columns have been treated, with some useful Remarks on those of *Paladio* and *Vignola*.

He says, if these *Orders* of Columns had any positive Beauties, easy and obvious to the Eye, Architects would have been oblig'd to agree among themselves, as to their Rules and Properties; but as their Beauties are in Effect merely arbitrary, and not founded on any certain Demonstrations, it happens, that those who have treated of them, have all prescrib'd different Rules, according as their Taste and Genius were different.

It must be own'd however, that tho' the same *Order* may have different Beauties, and different Proportions; yet among those Beauties and Proportions, 'tis certain there are some that please more, and are more universally approv'd than others.

Among the several Authors who have written on Architecture

ture, *Palladio* and *Vignola* seem to be the most generally follow'd; but it is a Doubt, even among Persons of Skill and Judgment, which of the two ought to be preferr'd to the other.

The Orders of *Palladio* have Beauties different from the Orders of *Vignola*. I mean their several Orders have each of them their different Beauties; and yet the great Difference between their Compositions, does hardly allow us to view them without making a Choice from some Circumstances.

For Instance, *Vignola's* Rule of making the Entablement in all the Orders just a fourth Part of the Height of the Column, pleases me less than that of *Palladio*, who diminishes this Height in the three last Orders. I mean that *Vignola's* Entablements appear heavy and lumpish, and especially in the *Ionie*, *Corinthian* and *Composite* Orders; and above all, when the Columns are without Pedestals,

On the other Hand, *Vignola's* Pedestals, whose Height in all the Orders is one third of that of the Columns, are in my Opinion preferable to the Pedestals of *Palladio*, which having less Height, appear flat and low.

Again, the Zocco of *Vignola's* Pedestal seems too little, and that of *Palladio*, too big and strong for the Pedestal.

Further, I cannot commend *Vignola* for giving *Vitruvius's* Base to the *Ionie* Column, and for excluding the *Attic* Base

out of all his Orders, which, without Dispute, is the most beautiful of all the Bases of Columns.

Palladio too, in my Opinion, had done better, if in Imitation of the Ancients he had given the *Attic* Base to the *Ionie* Column, instead of the *Doric*; in which last some more simple Base, as that for Instance of *Vignola*, would have been more suitable and consistent with the Solidity of the Order.

Add to these that a Man cannot view *Vignola's Tuscan* Order, without observing that of *Palladio* ill conducted almost in every Part; but especially in the Shaft of the Column, which indeed appears monstrous, on Account of its excessive Diminution towards the Top; even the smallest Share of Discernment is sufficient to discover this.

Methinks too, it had been more just in *Palladio*, if instead of Modillions in the *Ionie* Entablement, he had made Dentils, which, as *Vignola* has very well observ'd, are an essential Ornament of this Order: Modillions appearing too strong and massive for a Column that professes to imitate the Delicacy of a young Woman.

Nor does it appear over judicious in *Vignola*, to use Dentils in four of the Orders; it being a Point of Prudence in an Architect, to introduce a Diversity in the Ornaments, as well as the principal Members of his Orders.

And again, I can't but think it an oversight in *Vignola*, to make

make his Dentils less in the *Doric* Order, than in the *Ionian*, *Corinthian* and *Roman*; when tis own'd, that the *Doric* is considerably less delicate than any of those other Orders.

Who can approve of *Palladio's* making the *Corinthian* Column less delicate than the *Roman*, and the *Roman* Capital at the same Time less delicate than the *Corinthian*? Or was it just in *Vignola* to make the 2 Columns, *Corinthian* and *Composite*, in the same Proportion?

Ought not some Regard to be had to the Difference of their Capitals, and on that Account, should not some more Delicacy be shewn in the *Corinthian* Column, than the *Roman*?

Further it may be justly said, that if *Vignola* has made his Entablaments too heavy in the three last Orders, *Palladio* has made his too light.

I observe also, that *Vignola* has made his Modillions in the *Corinthian* Order, too large, insomuch that they encroach upon each other in the inner Angles of the Entablement; on which Account, the Roses inclos'd between them, appear too small, with Regard to those; which must be own'd to be a considerable Fault, that *Palladio* had the good Fortune to avoid, by making the Spaces between the Modillions perfect Squares.

Nor can it be deny'd that in *Vignola* the Die of the *Corinthian* Pedestal is too high, and in *Palladio*, too low for the Base,

Lastly, a Man cannot view *Vignola's* Porticos, without observing them to be better proportioned than those of *Palladio*, which are too wide in the two first Orders, and too narrow in the two last.

Were I to examine the Profiles of these two Authors, many of them would be found intolerable; being compos'd of Mouldings that are ill match'd to each other, and in no wise suitable to the Places where they are found.

Of the five Orders of Architecture, by equal Parts.

Every Order is comprehend'd under three principal Parts, viz. the *Pedestal*, the *Column* and the *Entablature*; and each Part consists of three Denominations; the *Pedestal* having its *Base*, *Die*, and *Cornice*; the *Column*, its *Base*, *Shaft*, and *Capital*; and the *Entablature*, its *Architrave*, *Frieze* and *Cornice*.

I. *Of the Tuscan Order.*

Any Height being given, divide it into ten Parts and three Quarters, call'd Diameters (by Diameters is meant the Thickness of the Shaft at the bottom) the *Pedestal* having two; the *Column* with *Base* and *Capital*, seven; and the *Entablature*, one and three Quarters.

II. *Of the Doric Order.*

The whole Height being given, is divided into twelve

Diameters or Parts, and one third; the Pedestal having two and one third, the Column eight, and the Entablature two.

III. *Of the Ionic Order.*

The whole Height is divided into thirteen Diameters and a half; the Pedestal having two and two thirds, the Column nine, and the Entablature one, and four fifths.

IV. *Of the Corinthian Order.*

The whole Height is divided into fourteen Diameters and a half; the Pedestal having three, the Column nine and a half, and the Entablature two.

V. *Of the Composite Order.*

The whole Height is divided into fifteen Diameters, and one third; the Pedestal having three and one third, the Column ten, and the Entablature two.

In a *Colonnade* or range of Pillars, the *Intercolumniation* or Space between two Columns in the *Tuscan Order*, is four Diameters. In the *Doric Order*, two and three Quarters. In the *Ionic Order*, two and a Quarter. In the *Corinthian Order*, two: And in the *Composite Order*, one and a half. See the Plate.

ORGANICAL Description of Curves is the Method of describing them on a Plane, by the Regular Motion of a Point.

ORIE } [in *Architecture*]
ORLET } a Fillet under
ORIO } the Ovolo or Quarter Round of a Capital. When it is at the Top or Bottom of the Shaft, it is call'd *Cincture*. *Palladio* uses the Word for the Plinth of the Bases of Columns.

ORNAMENTS [in *Architecture*] are us'd to signify all the Sculpture or carv'd Work wherewith a Piece of Architecture is enrich'd.

Vitruvius and *Vignola* also use the Word to signify the *Entablature*.

Ornaments in Relievo are those cut into the Contours of Mouldings, as Leaves, Shells, Scrolls, Flowers, &c.

Ornaments in Creux, are such as are cut within the Mouldings, as Eggs, Flutes, &c.

ORPIMENT is the same that some call *Tellow Asenick*. It is a good Colour for some Uses, but is very troublesome to grind, being a mineral, stony Substance of a poisonous Quality; therefore Care ought to be taken, that the Fumes of it don't offend the Brain, in the time of grinding it.

ORTHOGRAPHY [in *Geometry*] is the Art of drawing or delineating the fore right Plan of any Object, and of expressing the Heights or Elevations of each Part.

It is call'd *Orthography* from its determining Things by perpendicular Lines, falling on the Geometrical Plane.

ORTHOGRAPHY [in *Architecture*] is the Elevation of a Building.

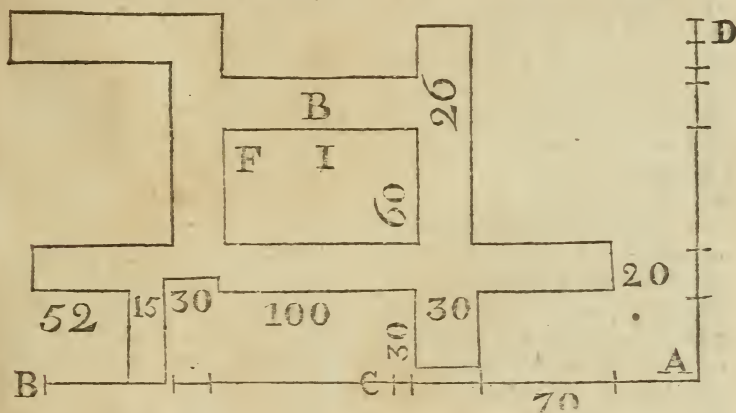
The *Orthography* is either *external* or *internal*.

The *external Orthography* is taken for the Delineation of a external Face or Front of a Building; or as it is by others defin'd, is the Model, Plat-form, and Delineation of the Front of a House, that is contriv'd, and to be built according to the Rules of *Geometry*, according to which Pattern the whole Fabrick is erected and finish'd. This Delineation or

Plat-form, exhibits the principal Wall, with its Apertures, Roof, Ornaments, and every Thing visible to an Eye, plac'd before the Building.

Internal Orthography, which is also call'd a *Section*, is a Delineation, or Draught of a Building, such as it would appear, were the external Wall removed.

To lay down the Orthography of a Building.



Draw a Right Line for a Base or Ground Line A B, and at one End erect a perpendicular A D upon A B, set off the Width and Distances of the Gates or Doors, Windows, &c. On the Right Line A D, set off the Heights of the several Parts visible in the Face of the Building, v. g. of the Doors, Windows, the Roof, Chimneys, &c. and apply a Ruler to each Point of Division.

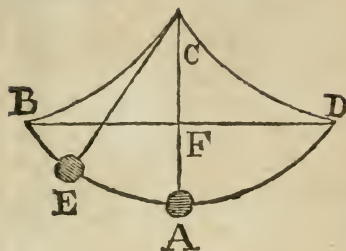
The common Intersections of the Right Lines, drawn from three Points, parallel to the Lines A B and A D deter-

mine the *external Orthography* of the Building; and after the same Manner, is the *internal Orthography* to be laid down.

ORTHOGRAPHY [in *Perspective*] is the fore right Side of any Plane, i. e. the Side or Plane that lies parallel to a strait Line, that may be imagin'd to pass through the outward Convex Points of the Eyes, continued to a convenient Length. *Lamy*, and others, use the Word *Scenography* in the same Sense.

OSCILLATION [in *Mechanicks*] is the Swing or reciprocal

procal Ascent or Descent of a Pendulum.



1. If a single Pendulum be suspended between two Semi-Cycloids BC, CD, which have the Diameter CE of the generating Circle equal to half the Length of the String, so that the String, as it oscillates, folds about them; all the Oscillations, however unequal, will be Isochronal in a non resisting Medium.

2. The Time of the intire or whole Oscillation thro' any Arch of a Cycloid, is to the Time of the Perpendicular Descent through the Diameter of the generating Circle, as the Periphery of the Circle to the Diameter.

3. If two Pendulums describe Similar Arches of Circles, the times of the Oscillations are in the Subduplicate of their Lengths.

4. The Number of Isochronal Oscillations made in the same time by two Pendulums, are reciprocally as the times wherein each of the Oscillations are made.

The Times of the Oscillations in different Cycloids, are in the sub-duplicate Ratio of the Length of the Pendulums.

5. The Length of a Pendu-

lum that will perform its Oscillations in a Second, is 3 foot, 8 Inches and a half of *Paris* Measure.

6. The shorter the Oscillations in the Arch of a Circle are, the truer will the Pendulum measure Time, or the more Isochronal will the Oscillations be.

Centre of OSCILLATION in a suspended Body, is a certain Point therein, each Vibration of which is perform'd in the same Manner, as if that Point alone were suspended at that Distance from the Point of Suspension. Or,

It is a Point wherein, if the whole Length of a compound Pendulum be collected, the several Oscillations will be perform'd in the same Time as before.

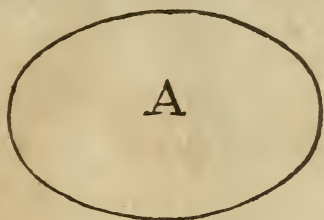
Therefore its Distance from the Point of Suspension is equal to the Length of a single Pendulum, whose *Oscillations* are Isochronal with those of the Compound one.

OVA [in *Architecture*] are Ornaments in Form of Eggs, carv'd on the Contour of the Ovolo or Quarter Round; and separated from each other by Anchors, or Arrow Heads, these Ornaments are ordinarily call'd *Eggs* and *Anchors*, by the *English*.

The Ancients sometimes us'd Hearts instead of Eggs, upon which Foundation it was, that they us'd Arrows to symbolize with Love.

OVAL or *Ellipsis* [in *Geometry*] is a Figure as A bounded by a regular curve Line, return-

returning into it self; but of its two Diameters cutting each other at Right Angles in the



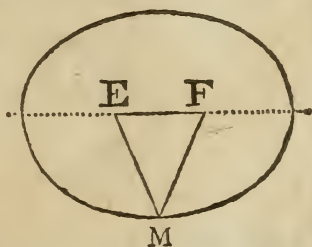
Centre, one is longer than the other, in which it differs from the Circle. Every *Ellipsis* is an *oval* Figure, but every *oval* Figure, is not an *Ellipsis*. Or,

An Oval may be defin'd a Figure inclos'd with a single curv'd Line, imperfectly round, its Length being greater than its Breadth; like an Egg, whence it takes its Name.

The proper Oval or Egg Shape, is an irregular Figure, being narrower at one End than the other; in which it differs from the *Ellipsis*, which is the mathematical Oval, and

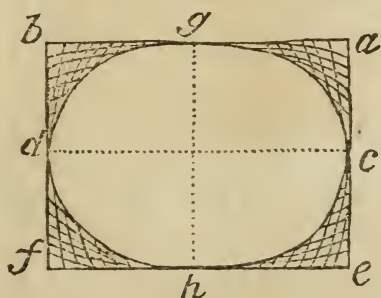
equal in Breadth at each End.

These two are confounded together by the common People, and even Geometricians call the Oval a false *Ellipsis*.



The Method commonly us'd by Workmen in describing an Oval, is by a Cord or String, as F M E, whose Length is equal to the greater Diameter of the Oval, and which is fastened by its Extremes to two Points or Nails, E, F, planted in its longest Diameter, by which Means the Oval is made as much longer, as the two Points or Nails are farther apart.

To draw an Oval by Intersection of Right Lines.

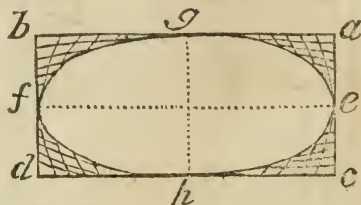


First, Describe the out Lines $a b$, $b e$, $f e$, and $e a$, at Right Angles to each other; afterwards draw the Conjugate Diameter $c d$, also the trans-

verse Diameter $b g$, and divide $a g$, and $a c$ into any Number of equal Parts; also $c b$ and $b d$, $d e$, and $f b$; and $b e$ and $e c$, and draw Right

Right Lines from Division to Division, as before, which will describe the Oval c, g, d, b , which was to be done.

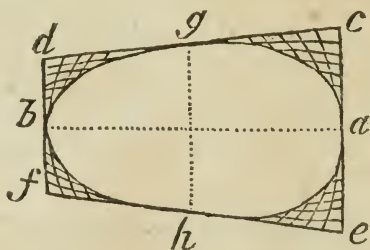
To describe an Oval, whose Transverse Diameter is less than in the preceeding next immediately preceeding.



First, Draw the Out-Lines $a b, b d, d c$, and $c a$, at Right Angles to each other; and afterwards draw the conjugate Diameter $e f$, also the transverse Diameter $g h$; then divide $a g$ and $a e$ into any Number of equal Parts; also

$g b$ and $b f$; $f d$, and $d b$ $b c$ and $c e$, from which, draw Right Lines as before, which will describe the Oval $e g f b$.

To draw an Egg or Oval, one End larger than the other.

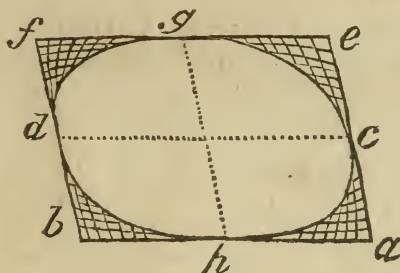


First, Draw the conjugate Diameter $a b$, afterwards draw Lines $e c$ and $f d$ at Right Angles with $a b$, so that $a c$ is equal to $a e$ and $b f$ is equal to $b d$; then draw the Lines $c d$ and $e f$, which divide in the middle at g and h , and draw the Line $g h$ for the transverse Diameter; then divide $e h$, and $c a$, and also $a c$, and $c g$ into any Number of equal Parts; and divide $b f, f b,$

$b d$, and $d g$ into any Number of equal Parts, and draw Right Lines to each Correspondent Division, and they will describe the Figure $a g, b h$, which is what was to be done.

To draw an oblique Oval.

First, Describe the Out-Lines $a b, a e, e f$ and $f b$, and draw the conjugate Diameter $c d$; also the transverse Diameter $h g$; and observe that $e f$ is equal to $a b$, and $b f,$



is equal to $a e$: then divide each Line, that is, between Letter and Letter, into one equal Number of Parts, and draw Right Lines as before, which will describe the Oval $c g d h$, which was requir'd.

OVOLO [in *Architecture*] is a round Moulding, whose Profile or Sweep in the *Ionic* and *Composite* Capitals, is usually a Quadrant of a Circle; whence it is also popularly call'd the *Quarter Round*.

It was usually enrich'd with Sculpture by the Ancients, in the Form of Chesnut-Shells, whence *Vitruvius* and others call'd it *Echinus*, i. e. *Chesnut-Shells*.

Among us, it is usually cut in the Likeness of Eggs and Anchors, or Arrow-heads, plac'd alternately.

OVICULUM [in the ancient *Architecture*] a little Ovum or Egg.

OVER-SPAN. See *Clamp*.

OXYGONE, [in *Geometry*] is the same as an acute angled Triangle.

OXYGONAL ? [in *Geo-*

OXYGONOUS } *metry*]

signifies acute angled; something with an Angle less than 90 Degrees.

P.

PADDUCK, or *Paddock* *Course*, a Piece of Ground conveniently taken out of a Park, usually a Mile in Length and a Quarter of a Mile in Breadth, encompass'd with Pales or a Wall, for exhibiting Races with Grey-Hounds, for Wagers, &c.

PAINTING [in *Oil*] the Art of Painting in Oil, was unknown to the Ancients, and was first discovered and put in practise in the Beginning of the XIV Century, by a *Flemish* Painter, nam'd *John van Eyck*, or *John de Bruges*. Painting before his Time, was all perform'd in *Fresco* or Water Colours.

This Invention was of very great Use to the Art of Painting, since by Means hereof, the Colours of a Painting, are preserv'd much longer and better, and receive a Lustre and Sweetness, which the Ancients could never attain to, what Varnish soever they made Use of, to cover their Pieces.

The whole Secret consists only in grinding the Colours with Nut-Oil or Linseed Oil: but the Manner of working is very

very different from that in *Fresco*, or in Water, by Reason that the Oil does not dry near so fast; so that the Painter has an Opportunity of touching and retouching all the Parts of his Figures, as often as he pleases; which in the other kinds of Painting is a Thing impracticable.

And besides, the Figures in this Way of Painting, have more Force and Boldness, in as much, as the Black becomes blacker when ground with Oil, than with Water. Besides, that all the Colours mixing better together, render the Colouring sweeter, softer, more delicate, and give an Union and Softness to the whole Work, which is inimitable in any of the other Manners.

Painting in Oil, is perform'd on Walls, Wood, Stone, &c. To paint on a Wall, when it is well dry, they give it two or three Washes of boiling Oil, till the Plaister remain quite greasy, and will imbibe no more. Upon this they lay drying Colours, *viz.* white Chalk, red Oker, or other Chalks, beaten pretty stiff. When this Couch or Lay is well dry, they sketch out and design the Subject to be painted, and at last paint it over, mixing a little Varnish with their Colour, to save the varnishing afterwards.

Others to fortify the Wall better against Moisture, cover it with a Plaister of Lime, Marble Dust, or a Cement made of beaten Tiles soak'd in Linseed Oil; and at last they prepare a Composition of *Greek*

Pitch, Mastick, and thick Varnish boil'd together. which is apply'd hot over the former Plaister: When this is dry, they lay their Colours on as before.

Others make their Plaister with Lime, Mortar, Tile Cement, and Sand; and when this is dry, they lay on another of Lime, Cement or Machefer, or Iron Scum; which being well beaten and incorporated with Whites of Eggs and Linseed Oil, makes an excellent Couch or Plaister, on which when it is dry, the Colours are laid as before.

In painting on Wood, they usually give their Ground a Couch or Lay of White, tempered with Size; or they apply the Oil above-mention'd: the Rest is after the same Manner as in painting on Walls.

To paint on Linnen or Canvas. The Canvases being stretch'd on a Frame, they give it a Couch or Lay of Size: When it is dry they go over it with a Pumice-Stone, to smooth off the Roughness. The Size lays all the little Threads and Hairs close on the Cloth, and the little Holes are stopp'd up, that no Colour can come through.

When the Cloth is dry, they lay on Oker, which is a natural Earth, and bears a Body, sometimes mixing with it a little white Lead to make it dry the sooner, and when it is dry, they rub it with a Pumice Stone to make it smooth.

After this, sometimes is added a second Lay, compos'd of White Lead and a little Char-
coal

coal black, to render the Ground of an Ash Colour; taking Care in each Manner to lay on as little Colour as possible, that the Cloth may not break, and that the Colours when they come to be painted over, may preserve the better.

Therefore as little Oil as possible is to be us'd, if you would have the Colours keep fresh; and therefore some mix them up with Oil of Aspic, which evaporates immediately, and serves to make them manageable with the Pencil.

To paint on Stones, it is necessary to apply Size, as on Cloth; it will be sufficient to add a flight Couch of Colours, before the Design is drawn.

PAINTING of Timber Work. The Manner of colouring all Manner of Timber-Work, as Waincot, Doors, Windows, Posts, Rails, Pales, Gates, Border Boards for Gardens, &c. which require either Beauty or Preservation from the Violence of Rain, or Injury of Weather, is as follows.

Suppose there be a Set of Palliades, or a Pair of Gates, or some Posts and Rails to be painted in a Stone Colour.

First, Look over the Work, and take Notice whether the Joints be open in the Gates, or whether there be any large Clefts in the Posts; for if there are not secur'd, the Wet will insinuate it self into those Defects, and make the quicker Dispatch in rotting the whole Work.

Therefore the first Thing to be done, is to stop up those

Clests, &c. smooth and even, with a Substage which Painters call *Putty*, which is made of Whiting and Linseed Oil, well beaten together on a grinding Stone, or with a wooden Mallet, to the Consistence of a very thick Dough, and with this, let all the Crannies, Clests and other Defects be well fill'd up, so that it may be equal to the Surface or out Side of the Things to be painted.

Then Prime the Work with *Spanish Brown*, well ground, and mixt very thin with Linseed Oil; with this do over the Work, giving it as much Oil as it will drink up; this in about two Days will be indifferent dry; then if you would do the Work substantially, do it again with the same Priming Colour; when it is thorough dry, take White Lead, well ground and tempered with Linseed Oil, but not too thin; for the stiffer you work it, if it be not too stiff, the better Body will be laid on, and the longer it will last; rub this Colour on well with a large Bristle Brush; that the whole Surface of the Work be so intirely covered, that no crack nor corner may remain bare; which may be easily done by jobbing in the Point of a Bristle Brush.

Let this first Colouring dry, and then go over it a second time, and if you please, a third also; the Charge will be but little more, but the Advantage will be great in the Duration.

This Course is sufficient for every

every Kind of Timber Work, which requires only a plain Colour; whether you cover the Work with a Stone Colour, or else with a Timber Colour with Umber and White, or a Lead Colour with Indigo and White.

Some lay over their Work only a Coat of *Spanish Brown*, by tempering it up more stiff than was done for the two first Primings, which, in some Respects, is the cheapest Way of all, and preserves the Timber perhaps as well as Any.

Note, If when you have made Use of your Colours, there be Occasion for a small Cessation, till the Work be finish'd; in this Case, you must cover the Colour that remains in the Pot with Water, which will prevent its drying and skinning over.

And the Pencils also or Brushes should be wash'd out in clear Linseed Oil; and then in warm Soap Suds; for if either Oil or Colours be once dry'd in the Brush, or Pencil, they are spoil'd for ever.

It has been observ'd, that Timber laid over with White when it has stood some time in the Weather, the Colour will crack and sink up together, just as Pitch does, if laid on any Thing that stands in the Sun; the Cause of this is that the Colour was laid on with too stiff a Body; for being wrought too thick once, it will dry with a Skin on the Outside, which will keep the Inside moist, and prevent its binding firm, from whence those Cracks proceed.

Of Out-Door painting in General.] Doors, Shop-Windows, Window - Frames, Pediments, Architraves, Friezes and Corniches, and all other Timber Works that are expos'd to the Weather, ought at first setting up, to be prim'd with *Spanish Brown*, *Spanish White*, and *Red Lead* (about a fifth) to cause the other two Colours to dry.

These being well ground with Linseed Oil, will make a very good Primer: Then afterwards with the same Colour, (but whiter) for a second Primer, and lastly with a fair White, made of White Lead, and about a fifth Part in Quantity, (not in Weight) of *Spanish White*.

Now he that is able to bring the Work thus far on, has proceeded to the highest Pitch of that vulgar Painting, that aims at Preservation beyond Beauty, tho' something of Beauty is necessarily included in this also; but this is not all, for he that is arriv'd thus far, is in a fair Way to other Perfections in the Art of Painting; but for the Panelling of Wainscot with its proper Shadows, and for imitating Olive and Walnut Wood, Marbles, and such like, these must be attain'd to by ocular Inspection, it being impossible to deliver the Manner of the Operation by Precept, without Example; and I am bold to affirm, that a Man shall gain more Knowledge by one Day's Experience, than by an Hundred spent to acquire it some other Way.

I advise therefore all those that desire an Insight into the Business, to be a little curious, if Opportunity offers, in observing the Manner of a Painter's Working, not only in grinding his Colours, but also in laying them on, and working in them; in all these observing the Motion of his Hand, in the manage of any Kind of Tool; and by this Means, with a little Imitation, join'd to the Directions here given; I doubt not but in a short time, you may arrive to great Proficiency in the Business of vulgar Painting.

Take Notice, that if you shall at any Time have Occasion to use either Brushes that are very small, or Pencils, as in many Cases there will be Occasion, you ought then to dispose of the Colours you use upon a Pallet (*which is a wooden Instrument, easy to be had at any Colour-Shop*) and there work and temper them about with your Pencil, that the Pencil may carry away the more Colour; for you are to Note, that if a Pencil be only dip't in a Pot of Colour, it brings out no more with it than what hangs on the Outside, and that will work but a little way, whereas if you rub the Pencil about in the Colour, on the Pallet, a good Quantity of Colour will be taken up in the Body of the Pencil; and besides all this, you may work your Pencils better to a Point on a Pallet, than you can do in a Pot; the Point of a Pencil being of greatest Use in divers Cases, especially in drawing of

Lines, and all kind of Flourishing.

How to scour, refresh and preserve all Manner of Oil Paintings.

The Oil Paintings that I here intend, are only such as are kept from the Injuries of Weather; for such Paintings as endure the Fury of Rain and Storms (such as Sun-Dials, Posts, Pales, &c.) are not any ways to be renewed or refreshed, but by being new coloured with the same Colour, in which it was at first wrought, because that the Body and Strength of the Colour, is worn out by continual Assaults of wasting Time, and cannot be made fresh, unless new done over once in four or five Years, or more according as the Weather is found to wear it off, and make it look dull.

But as for such Painting that is shelter'd from Weather, as all In-Door Paintings are, they still keep their Body and Colour, although their Beauty may be much impaired by Dust, Smoak, Fly-shirts, and the like, which will in time soil and tarnish them; to remedy which, take these few Rules:

If your Painting be Wainscoting, or any other Joinery or Carpentry Work that is painted in Oil, take Wood-Ashes well sifted, which mix with Water somewhat thick, then take a large strong Bristle Brush, and dip it in the moistened Ashes, and therewith rub and scour your Painting all

over very gently in all Places alike, and you will find that all the Soil is taken off, then wash it clean with fair Water, and let it dry; and you will find your Painting to be near as fresh as when laid on.

But if your Painting be more curious, whether Figures of Men, Beasts, Landkip, Fruitage, Florage, or the like, then let your Picture be gently scoured, and then cleanly washed off with fair Water; after it is well dry, let it be run over with Varnish, made with White of Eggs, and you will find the Beauty and Lustre of your Picture much recovered.

The Whites of Eggs before-mentioned, are only to be beaten to an Oil, and then curiously rubbed on either with a clean Linnen-Cloth, or a Pencil.

But *Note*, That this scouring of Pictures ought not to be practised but very seldom (*as when your Picture is very much soiled*) because often and too frequent doing this, must needs wear off a little of the Colours; therefore strive what you can to preserve their first Beauty, by keeping them free from Smoak, and by often striking off the Dust with a Fox-Tail; as likewise preserving them from Flies, by burning Brimstone sometimes to kill them, or by dressing up your Rooms with green Boughs, to which the Flies will gather themselves, and so not hurt your Pictures.

Sir *Hugh Platt* in the first Part of his *Garden of Eden*,

and 17 *Page*, tells us of an *Italian* Fancy for that Purpose, by hanging in the Roof and Sides of the Room small Pom-pions or Cucumbers stuck full of Barley, which will sprout into green Spiers, on which the Flies will lodge. *Query*, Whether a Vessel of Tin made round about full of Holes filled with Earth, and every Hole planted with a Corn of Barley, and watered as Need requires, would not be more beautiful and useful to this Purpose?

Another Note worth Observation is, that all Pictures (*especially those that are wrought with Mixtures of White Lead*) are apt to tarnish and grow rusty, as is seen in all ancient Pieces; to prevent which, in the Months of *May* and *June*, let your Pictures be exposed sometimes to the hot Sun, for this will draw off much of the tarnish, and make the Colours more fresh and beautiful: and thus doing from Year to Year, will preserve them wonderfully.

Out Door Work thus coloured, may be afforded to be done for 3*d.* 3½*d.* or 4*d.* the Yard Square, for each time laid over.

Of Measuring.] Painters measure their Work by the Yard superficial, and in taking the Dimensions of their Work, they run a String all over where the Brush has been, for they say (and it is but Reason) that they ought to be paid for all where the Brush goes.

But sometimes in Rails or Bannisters, they will measure it,

it, as if it were flat Measure ; and indeed upon trying the Experiment, there has been so little Difference found, that it would not countervail the Trouble of girting and casting up.

So that Painters Work is measured the same as Joiners, only Painters never reckon Work and Half, but work once, twice, three times, &c. done over ; or at so much *per* Yard, according to the Work.

They always reckon double Work for painting Window Shutters, if both Sides are painted alike, otherwise according to the Value of the Painting.

They reckon Sash-Frames by themselves (at so much *per* Piece, and likewise Mantle-Pieces) when there is no Painting about them ; but if they stand in the Wainscot, they measure them as plain Work, not deducting any Thing for the Vacancy.

Wainscot Colour] If on new Stuff, is worth about 8*d.* *per* Yard, on old Colour, about 7*d.*

Walnut-Tree Colour.] Some say it is worth 10*d.* but others, 16 or 18*d.* *per* Yard.

Ordinary branch'd Painting] It is said to be worth 12*d.* 14*d.* or 16*d.* *per* Yard.

Ordinary Marble Colour.] If on new Stuff, is worth 1*s.* *per* Yard, on old Stuff, 9*d.* -

White Colour] is worth 10*d.* or 1*s.* *per* Yard.

Plain Japan, either black or white] is worth 3*s.* 6*d.* or 4*s.* *per* Yard.

Gates and outward Doors] are worth 3*d.* 3½*d.* or 4*d.* *per* Yard,

Shop-Windows] are of the same Price as Gates and outward Doors.

Window Frames] are worth from 3*d.* to 8*d.* each Light, according to their Size.

Sash-Lights] are worth about 1*s.* *per* Light.

Sash-Frames] are worth about 1*s.* *per* Frame.

Iron Casements] are worth Three Half pence, 2*d.* or 3*d.* *per* Casement, according as they are in Bigness.

Iron Bars of Windows] are worth 1*d.* *per* Bar, or more, if very large.

Chimney-Pieces] are worth about 2*s.* *per* Chimney-Piece.

Pales are worth about 10*d.* or 1*s.* *per* Yard.

Colours.] The Colours us'd in Painting are, *White* and *Red Lead*, *Spanish*, *White Brown*, *Verdigrease*, *Smalt*, &c.

Painters Work.

The taking of the Dimensions, is the same with that of Joiners, by girting over the Mouldings &c. in taking the Height, and it is but reasonable that they should be paid for what both their Time and Colour are expended in. The casting up after the Dimensions have been taken and reduc'd into Yards, is altogether the same with that of Joiners Work ; but the Painter never reckons Work and Half ; but reckons his Work once, twice or thrice colour'd over.

But this is to be remembred, that Window-Lights, Window-Bars, Casements, and such like Things,

Things, are done at so much
per Piece.

Example. If a Room be painted, whose Height (being girt over the Mouldings) is 16 Feet 6 Inches, and the Compass of the Room be 97 Feet

9 Inches, how many Yards are in that Room?

Multiply 97 Feet 9 Inches, by 16 Feet 6 Inches, and the Product will be 1612 Feet, 10 Inches, 6 Parts; which being divided by 9, the Quotient will be 179 Yards and 1 Foot.

F.	I.	
97	9	
16	6	
<hr/>		
584		
98		
48	:	10 : 6
<hr/>		
9)1612	:	10 : 6

Facit 179 Yards, 1 Foot.

97.75
16.5
<hr/>
48875
58650
9775
<hr/>
1612.875

By Scale and Compasses.

Extend the Compasses from 9 to 16.5, and that Extent will reach from 97.75 to 179 2 Yards.

PALE [in *Carpentry*] a little pointed Stake of Wood, us'd in making Inclosures, Separations, &c.

PALES } are Rows or Files

PILES } of Stakes driven into the Ground, to make wooden Bridges over Rivers, they serve to support the Beams which are laid across them from one Row to another; and are strongly bound together with cross Pieces.

PALEING with cleft Pales, Rails and Posts. For paleing with 3 Rails, Cleft Pales, Rails and Posts, cleaving, making, and setting up, the usual Price is said to be 3 s. 6 d. or 4 s. *per Rod*, felling the Timber and all; but then they must have

their Materials all laid down to their Hand, so that they have no carrying.

Some say they have 2 s. 6 d. *per Rod* for only making and setting up of Clefts Posts, Rails, and Pales.

Sawn Pales, Rails and Posts, some say are set up at 1 s. 6 d. *per Rod*.

The Price of Cleaving Pales is about 20 d. or 2 s. *per Hundred*.

A hundred of Pales varies according to their Length; for of five Foot Pales, five Score makes a hundred; of four Foot Pales, six Score, and of three Foot, seven Score go to the Hundred.

It is very uncertain what Number a Tun of Timber will make, by Reason of the Difference of the Timbers cleaving, some cleaving much better (and with less waste) than other.

But

But a Tun of good cleaving Timber, may make about 300 of 4 Foot Pales, or 400 of 3 Foot Pales; because the Timber generally cleaves better and less to waste in short Lengths, than in longer.

But the Number of *sawn*

Pales that may be made out of a Tun of Timber is more certain than that of *Cleft-Pales*, for it has been found, that a Tun of Timber will make about 400 Foot of Inch Boards, (the Timber being of fit Length) being cut out

into $\left\{ \begin{array}{l} 5 \\ 4 \\ 3 \end{array} \right\}$ Foot $\left\{ \begin{array}{l} \text{Pales, will} \\ \text{make} \end{array} \right\}$ $\left\{ \begin{array}{l} 80 \\ 100 \\ 130 \end{array} \right\}$ Pales each a Foot broad;

which in Palsing will reach about three times as far as the like Number of Cleft Pales will do.

PALLISADE $\left\{ \begin{array}{l} \text{is a Sort of} \\ \text{PALLISADO} \end{array} \right\}$ slight open Pale or Fence, set to beautify the Place, Walk; &c.

There is such Variety in the Workmanship of Pallisado Pales, that there can be no certain Price by the Rod.

Pallisado Gates are as various in their Forms and Fashions as Pallisado Pales, and consequently their Prices are also as various, *viz.* from 6 or 7 to 10 or 12 *s.* per Yard, running Measure at about 7 Foot high.

Iron Pallisado Work in Gates or otherways, is from 4 *d.* per Pound, to 8 *d.* according to the Work.

PALLIFICATION [in *Architecture*] is the piling of the Ground Work; or strengthening it with Piles or Timber driven into the Ground; which is practis'd when they build upon a moist or marshy Soil.

PALLIER $\left\{ \begin{array}{l} \text{[in Building]} \\ \text{PAILLIER} \end{array} \right\}$ is sometimes

us'd for a Landing Place in a Stair Case; or a Step, which

being broader than the Rest, serves to rest upon.

PANNEL [in *Joinery*, &c.] is a Tympanum or square Piece of thin Wood, sometimes carv'd, fram'd or grov'd in a larger Piece between two Montants or upright Pieces, and two Traverses or cross Pieces.

PANNELS or Panes of Glass are Compartiments or Pieces of Glass.

PANNEL [in *Masonry*] is one of the Faces of a hewn Stone.

PANNIER [in *Architecture*] See *Corbel*.

PANTHEON [in *Architecture*] is a Temple or Church of a Circular Form; dedicated to all the Gods, or all the Saints.

PANTRY, a Room to set Victuals in; a Store Room.

PAN-Tiles, See *Tiles*.

PARABOLA is a Curve, as E D F made by cutting a Cone by a Plane D G parallel to one of its Sides, as in the Figure; See *Plate*, Fig. 1,

PARABOLICK *Pyramidoid*, is a solid Figure, generated by supposing all the Squares of the Ordinates. Applies in the

the Parabola, so plac'd as that the *Axis* shall pass through all their Centres at Right Angles; in which Case, the Aggregate of the Planes, will be arithmetically proportional; whose Solidity is gain'd by multiplying the Base by half the Altitude.

PARABOLICK Space, is the Area contain'd between the Curve of the Parabola, and a whole Ordinate A B.

This is $\frac{2}{3}$ of the circumscribing Parallelogram A CDB in the common Parabola; See the *Plate*, Figure 2.

PARABOLICK CUNEUS, is a Solid mention'd by Dr. *Wallis*, and is form'd thus; multiply all the D B's into the D S's, or which is all one upon the Base A F B erect a Prism, whose Altitude shall be A S, and this shall be the Parabolick Cuneus, which is equal in Solidity to the *Parabolical Pyramidoid*; See the *Plate*, Figure 3.

PARABOLICK SPINDLE is a Solid made by the Relation of a Semi-Parabola about one of its Ordinates, and is equal to $\frac{8}{15}$ of its circumscribing Cylinder.

PARABOLOIDES

PARABOLIFORM Curves are Parabolas of the higher Kind.

PARALLEL [in *Geometry*] is a Term apply'd to Lines, Figures and Bodies, which being prolonged, are still at equal Distance from one another.

PARALLEL Planes are those Planes which have all the Perpendiculars drawn be-

twixt them, equal to each other; that is, when they are equally every where distant.

PARALLEL RULER is an Instrument of Wood, Brass, &c. consisting of two Parallel Rules, which open and shut parallel to one another, and is of great Use in all Parts of Mathematicks, where many parallel Lines are to be drawn.

PARALLEL Rays [in *Opticks*] are those that keep an equal Distance from the visible Object to the Eye, which is suppos'd to be infinitely remote from the Object.

PARALLELISM is the Quality of a *Parallel*, or that which denominates it such, or it is that whereby two Things, *v. gr.* Lines or Rays, become equi-distant from one another.

PARALLELOGRAM [in *Geometry*] is a Right Line, quadrilateral Figure, whose opposite Sides are parallel and equal.

1. The opposite Angles of all Parallelograms are equal to one another.

2. All Parallelograms that are between the same Parallel Lines, and on one and the same Base, are equal.

3. All Similar Parallelograms are to one another in the duplicate Ratio of their homologous Sides.

4. The Area of any Parallelogram is had by multiplying one of its Sides by a Perpendicular let fall from one of the opposite Angles.

PARALLELOGRAM, is also an Instrument made of five Rulers of Brass or Wood, with Sockets

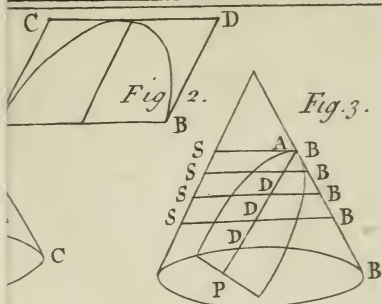


Fig. 4.

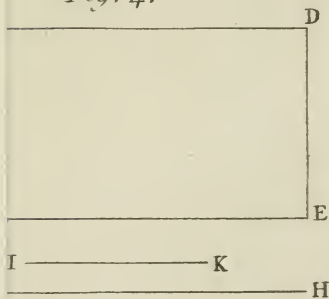
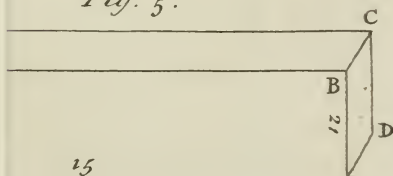


Fig. 5.



Sockets to slide or set to any Proportion, us'd to enlarge or diminish any Map or Draught, either in Building, Surveying, &c.

To describe the oblong PARALLELOGRAM A D F E, whose Length shall be equal to the given Line G H.

First, make F C = to G H, and on E erect the Perpendicular E D = I K; then on D with the Radius G H, describe the Arch B B; and on the Point F with the Radius I K, describe the Arch C C.

Secondly. Join A F and A D and they will compleat the Oblong. See the *Plate*, Figure 4.

PARALLELOGRAM-MICK PROTRACTOR, is a Semi-Circle of Brass, with four Rulers, in Form of a Parallelogram made to move to any Angle; one of which Rulers is an Index, which shews on the Semi-Circle, the Quantity of any inward or outward Angle.

PARALLELOPIPED [in *Geometry*] is a solid Figure contain'd under six Parallelograms, the opposite Sides of which are equal and parallel;

See the Work of all these.

or 'tis a Prism, whose Base is a Parallelogram, this is always triple to a Pyramid of the same Base and Height.

Let A B C D E F G be a Parallelopipedon or a square Prism, representing a square Piece of Timber or Stone, each Side of its Square Base A B C D, being 21 Inches, and its Length A E, 15 Foot.

First, then multiply 21 by 21, the Product is 441, the Area of the Base in Inches; which multiply'd by 180, the Length in Inches, and the Product is 79380, the Solid Content in Inches.

Divide the last Product by 1728, and the Quotient is 45.9, that is 45 Solid Feet and 9 Tenths of a Foot; Or thus, multiply 441 by 15 Feet, and the Product is 6615; divide this by 144, and the Quotient is 45.9, the same as before.

Or thus, by multiplying Feet and Inches.

Multiply 1 Foot 9 Inches, by 1 Foot 9 Inches, and the Product is 3 Feet 0 Inches, 9 Parts; this multiply'd again by 15 Feet, gives 45 Feet, 11 Inches, 3 Parts; that is 45 Feet, and $\frac{11}{12}$ of a Foot, and $\frac{3}{4}$ of $\frac{1}{12}$.

21
21
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21
42
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441
180
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35280
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	2205	
	441	
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144)	6615	(45 : 9
	<hr/>	
	855	
	1350	
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	54	
	14	

F.	I.
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1	9
1	3 9
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3	0 9
15	
<hr/>	
45	3 9

P A

1728) 79380 (45 : 9

6912

10260

8640

16200

15552

648

7 6

3 9

45 11 3

By Scale and Compasses.

Extend the Compasses from

25

9

225

25

1125

450

5625

144) 5625 (39

432

1305

1296

09

Answer 39 Feet.

P A

13 to 21, and that Extent will reach to near 46 Foot, being twice turn'd over from 15 Foot; so the Solid Content is almost 46 Feet.

If the Base of the Square solid, be not an exact Square; but in the Form of a Rectangled Parallelogram, the Way of measuring it is much the same; for first you must find the Area of the Base by multiplying the Breadth by the Depth, and then multiply that Area by the Length of the Piece, as before: thus,

If a Piece of Timber be 25 Inches broad, 9 Inches deep and 25 Feet long, how many solid Feet are contain'd therein?

F.

I.

2

1

0

9

1

6 9

25

25

12

1

0

39

: 0 0

: 6 0

: 0 6

: 6 3

: 0 9

By Scale and Compasses

First, Find a mean Geometrical Proportional between the Breadth and the Depth; which to do upon the Line of Numbers, you must divide the Space upon the Line between the Breadth and the Depth into two equal Parts; that middle

Point will be the mean Proportional sought: Thus the middle Point between 25 and 9 is at 15: So is 15 a mean Proportional between 9 and 25: for 9:15::15:25; so a Piece of Timber 15 Inches square is equal to a Piece 25 Inches broad, and 9 Inches deep.

So then if you extend the Compasses

Compasses from 12 to 15, that Extent turn'd twice over from 25¹ Feet; the Length will reach to 39 Feet, the Content. See *Plate*, Figure 5.

PARALLELOPLEURON [with some *Geometricians*] is a Word us'd to signify an imperfect Parallelogram, or a kind of *Trapezium*, having unequal Angles and Sides, yet not also in regard that at least some of them answer to one another, observing a certain Regularity and Proportion of Parallels; so that they do not extend so largely as *Trapeziums*, which are any irregular four sided Figures; nevertheless like them they are capable of being variously diversified.

PARAMETER [in *Geometry*] a constant Right Line in several of the Conic Sections, call'd also *Latus Rectum*.

PARASTATA [in the ancient *Architecture*] an Impost or kind of *Anta* or *Pilaster*, built for the Support of an Arch, or as some will have it, Pilasters which stand alone, not adjoining to the Wall. *Daviler* makes Parastata the same as *Impost*; but *Evelyn*, the same as *Pilaster*.

PARAPET [of the *Italian Parapetto*, a save-Breast] is a little Wall, or sometimes a Rail, serving either as a *Rest* for the Arm, or as an Inclosure about a Key, Bridge, Terras, &c.

PARGETING [in *Building*] is us'd for the plaistering of Walls; sometimes it is us'd to signify the Plaister itself.

As to the various Kinds, &c.

1. With Lime, Hair and Mortar laid upon bare Walls, at 3 *d.* or 4 *d.* the Yard.

2. Upon bare Laths, as in Partitioning and plain Ceilings from 8 *d.* to 14 *d.* per Yard.

3. Rendring the Insides of Walls, or doubling Partition Walls, at 2 *d.* or 3 *d.* per Yard.

Rough casting upon Heart-Laths, from 1 *s.* to 3 *s.* per Yard, Workmanship, and all Materials.

5. Plaistering upon Brick-Work, with finishing Mortar in Imitation of Stone Work, from 1 to 2 *s.* per Yard Square.

6. The like upon Heart-Laths, from 18 *d.* to 2 or 3 *s.*

PARLOUR, a fair lower Room design'd principally for the Entertainment of Company.

Aliquant PART, is a Quantity, which being repeated any Number of Times, becomes always either greater or less than the whole; thus 5 is an Aliquant Part of 17, and 9 an Aliquant Part to 10.

Aliquot PART, is a Quantity which being repeated any Number of Times, becomes equal to the whole.

PASS - PAR - TOUT; a master Key or Key that opens indifferently several Locks, belonging to the same Lodge or Apartment.

PASSAGE, an Entry or narrow Room, serving only for a thoroughfare or Entrance into other Rooms.

PATER - NOSTERS [in *Architecture*] are certain Ornaments plac'd underneath the Ovolo's

Ovolo's, cut in the Form of Beads, round or Oval.

PAVEMENT a Lay of Stone or other Matter, serving to cover and strengthen the Ground of divers Places for the more commodious walking on.

In some Places, as in *France*, the publick Roads, Streets, Courts, &c. are pav'd with *Gres*, a kind of Free Stone.

In *Venice*, the Streets, &c. are pav'd with Brick; Churches sometimes with Marble, and sometimes with Mosaic Work, as the Church of St. Mark, at *Venice*.

In *Amsterdam* and the chief Cities of *Holland*, they call their Brick Pavement, the *Bourgher Masters Pavement*, to distinguish it from the Stone or Flint Pavement, which is usually in the middle of the Street, serving for the Passages of their Horses, Carts, Coaches and other Carriages; the Brick Borders being design'd for the Passage of People on Foot.

In *England* the Pavement of the Grand Streets, &c. are usually Flint or Pebbles, Courts, Equerries, Kitchens, Halls, Churches, &c. are usually Tiles, Bricks, Flags or Fire-Stone; sometimes a kind of Free-Stone and Rag-Stone.

Pavements of Free-Stone, Flint and Flags in Streets &c. are laid dry, *i. e.* are retained in a Bed of Sand, those of Courts, Equerries, Ground Rooms, &c. are laid in a Mortar of Lime and Sand, or in Lime and Cement, especially if there be Vaults or Cellars underneath.

Some Masons after laying a Floor dry, especially of Brick, spread a thin Mortar over it, sweeping it backward or forwards, to fill up the Joints.

PAVEMENT of a *Terras*, is that which serves for the Covering of a Platform, whether it be over a Vault, or on a wooden Floor.

Those over Vaults, are usually Stones squared and bedded in Lead.

Those on Wood are either Stones with Beds for Bridges; Tiles for Ceilings in Rooms, or Lays of Mortar made of Cement and Lime with Flints or Bricks, laid flat, as is still practis'd by the Eastern and Southern People, a Top of their Houses.

PAVING is the Laying a Floor with Stones, Bricks or Tiles.

Paving or laying with *Free-Stones*, *i. e.* with broad Stones, taken out of the Quarries, and cut into Lengths and breadths promiscuously (as they will hold, and in Thickness about two or three Inches, is usually reckon'd at 6 *d.* 7 *d.* or 8 *d.* the Foot square, or 4 *s.* 6 *d.* 5 *s.* 3 *d.* and 6 *s.* the Yard Square, for Stone and Workmanship.

This kind of Paving is laid in common Yards and Passages, before Shop Doors, Stalls, &c.

But if the Stones be squared all to a Size (as sometimes these Stones are cut perfectly square, as paving Tiles are; but much larger, as 18, 20 and 24 Inches Square and upwards) then as they are neater, so they

they are dearer, as 12 *d.* or 14 *d.* per Foot, or 9 *s.* or 10 *s.* 6 *d.* per Yard.

But if the Stones thus squar'd and siz'd be good and well polish'd (as they ought to be for Kitchens, Dairies and neat Places) then they may be worth 15 or 16 *d.* per Foot, or 11 *s.* 3 *d.* or 12 *s.* per Yard square.

Paving with Rigate Stones]. This kind of Pavement is good for Chimney Fire Hearths, Ovens, Stoves, &c. and it is sometimes dearer than common *Purbeck Pavement*. See *Fire Stone*.

Paving with Marble is of all other the most beautiful, of which there are several Sorts, as white, black and grey: Some Pavements (as of Foot Paces before Chimneys) are laid all of one Sort or Colour, and in one intire Stone; others of two Colours, laid square or checquer Ways; the Side of the one, by the Side of the other; others are laid Arrace-wise of two Colours, laid Angle to Angle, and this last is the neatest Way.

But there may be divers Forms contriv'd to lay them in, as may be seen in several Chancels, in the Choir of *St. Pauls*, and the *Royal Exchange* in *London*, and divers other Places.

This Sort of Pavement is valued from 2 to 3 *s.* per Foot square and upwards according as 'tis well laid and polish'd. See *Marble*.

Paving with Rough or Rag Stone, is the cheapest of all

Pavements, and is valued from 15 to 18 *d.* per Yard.

Paving with Statute Bricks. This is done at *London* for about 4 *d.* per Yard.

But it is said, that a Workman has in *Sussex* 5 or 6 *d.* per Yard; but then into this Price they make ready the Floor for the Work; by clearing out the Earth, and levelling the Floor with a convenient Quantity of Sand (if they lay the Bricks dry, as sometimes they do) which they spread evenly with a Rake) then laying the Bricks level by a Line, they with a Trowel put a sufficient Quantity of Sand under each Brick, to raise it full as high as (or a little higher than) the Line, and so knock it down level with the Line, with the Handle of their Hammer, which when they have done, they ram in the Sand (on the Side of, and) against the Bottom of the Brick, with the Handle of their Hammer, to make it lie fast.

The whole Floor being laid after this Manner, they strew Sand all over the Bricks, to the Thickness of an Inch, and order the People of the Family to let it lie so for five or six Weeks, only sweeping it to and fro' now and then; that thereby, and by Means of their treading on it, it may fill up all the Joints between the Bricks.

If the Bricks are laid in Mortar, the Price is much the same as if they were laid dry.

There are some Masons who when they have laid the Floor dry,

dry, will spread the Floor all over with very thin Mortar, and sweep it to and fro' with a Broom, to fill up the Joints of the Bricks.

This Sort of Paving (with common Statute Bricks) is usual for Cellars, Wash-Houses, Sinks, Fire-Hearths, and for Halls and Kitchens in common Houses.

32 of these Bricks will pave a Yard square, if laid flat ways; and 64, edge ways.

Paving with square Tiles, or as they are call'd by some, Pav-

ing Bricks.

The Paving with square Tiles, is commonly valued by the Square, and by how much the Tiles are the smaller, by so much the dearer.

These Tiles are of several Sizes, viz. 6, 8, 10 and 12 Inches square; their Price from 6 to 20 s. per Hundred.

In *Suffex*, 9 Inch Tiles are sold for 1 d. per Tile or 8 s. per Hundred.

If you would know how many of either of these Sort of Tiles will pave any Floor,

Note that $\left\{ \begin{array}{l} 36 \\ 21 \\ 16 \\ 13 \\ 9 \end{array} \right\}$ Tiles of $\left\{ \begin{array}{l} 6 \\ 8 \\ 9 \\ 10 \\ 12 \end{array} \right\}$ Inches square, will pave a square Yard.

Paving with Flemish Bricks] The Paving with these Bricks, is far neater and stronger than common Bricks. The Colour of them is a dirty yellow, and they must be laid in Sand. These Bricks are six Inches and a quarter long, two Inches and a half broad, and one Inch and a quarter thick.

Now allowing a quarter of an Inch for the Joint, then 72 of them will pave a Yard square; but if they be set edgeways, then it will require 100 Bricks to pave a Yard square.

These Bricks are usually sold at 2 s. the Hundred, and the Price of laying them is 4 d. 5 d. or 6 d. the square Yard.

Diamond Pavement, Mr. *Wing* says is worth 3 d. or 4 d. per Foot.

Random Pavement.] This Mr. *Wing* says at the Quarry, is worth $2\frac{1}{2}$ d. or 3 d per Foot.

Of the measuring of a Pavement.] This is commonly measured by the Yard square.

Therefore take the Length of any Pavement in Feet and Inches, and multiply it by the Breadth in Feet and Inches, by *Cross Multiplication*, which see, and the Product will be the Content in Feet; which being divided by 9 (because 9 square Feet make a square Yard) will give the Content in Yards requir'd.

PEDIMENT [in *Architecture*] is a kind of low Pinnacle, serving to crown an Ordinance, or finish a Frontispiece, and is plac'd as an Ornament over Gates, Doors, Windows, Niches, Altars, &c. it is ordinarily

rily of a triangular Form; but sometimes makes an Arch of a Circle.

Vitruvius observes that the Pinnacles of the plainest Houses, gave Architects the first Idea of this noble Part, which still retains the Appearance of its Original.

The Parts of a Pediment are the *Tympanum* and the *Corniche*.

The first is the Pannel, naked or Area of the Pediment, inclos'd between the Corniche which crowns it, and the Entablature which serves it as a Base or Socle.

Architects have indeed taken a great Deal of Liberty as to the Form of this Member.

The most beautiful according to *Daviler*, is where its Height is about $\frac{1}{3}$ of the Length of its Base.

Vitruvius calls the Pediment *Fastigia*, which signifies a Roof rais'd or pointed in the middle, which Form among the *Romans*, was peculiar to Temples.

All their Dwelling Houses are cover'd in the Platform Manner; and it is observ'd by *Salmasius* on *Solin*, that *Cæsar* was the first who obtain'd Leave to Roof his House with a Ridge or Descent, after the Manner of Temples.

The *Pediment* is usually triangular, and sometimes an equilateral Triangle, call'd also a *pointed Pediment*, it is sometimes circular, tho' it has been observ'd by *Mr. Felibien*, that we have no Instance of round Pediments in the an-

tique, besides those in the Chapels of the *Rotundo*.

Sometimes its upper Corniche is divided into three or four Sides or Right Lines. Sometimes the Corniche is cut or open a Top, which is an Abuse introduc'd by the Moderns, particularly *Michael Angelo*; for the Design of this Part at least over Doors, Windows, &c. being chiefly to shelter those underneath from the Rain; to leave it open in the middle, is to frustrate its Ends.

Sometimes the Pediment is form'd of a couple of Rolls or Wreathes like two Consoles join'd together.

Sometimes the Pediment has no Base, or its lower Corniche is cut out, all but what is bestow'd on two Columns or Pilasters, and on these is rais'd an Arch or Sweep, instead of an Entablature; of which *Serlio* gives an Instance in the Antique in a *Corinthian Gate at Foligni in Umbria*; and *Daviler*, a modern one, in the Church of *St. Peter at Rome*.

Under this kind of Pediments, come those little arch'd Corniches, which form Pediments over Doors and Windows, supported by two Consoles, instead either of Entablature or Columns.

Sometimes the Pediment is made double, *i. e.* a less Pediment is made in the Tympanum of a larger, on Account of some Projecture in the middle, as in the Frontispiece of the Church of the great *Jesus at Rome*: But this Repetition

is accounted an Abuse in Architecture, altho' it be authoriz'd by very good Buildings, as the large Pavilion of the *Louvre*, where the *Caryatides* support three Pediments one in another.

Sometimes the Tympanum of the Pediment is cut out, or left open to let in Light, as is seen under the Portico of the Capitol at *Rome*.

Lastly this open Pediment is sometimes triangular, and enrich'd with Sculpture, as Roses, Leaves, &c. as is found in most of the *Gothic* Churches.

M. *Le Clerc* observes, that the Modillions in the Corniche of the Pediment, should always answer exactly over those of the Entablature.

Indeed *Vitruvius* says, the Ancients did not allow any Modillions at all in Pediments.

M. *Le Clerc* also observes, that the Corniche which serves the Pediment as a Base, should have no Cymatium, by Reason the Cymatium of the Rest of the Entablature when it meets the Pediment, passes over it.

This Change of Determination occasions a considerable Difficulty; the Cymatium in this Case, appearing too broad in the Turn of the Angle; to remedy which, Architects have Recourse to several Expedients.

A pointed Pediment may crown three Arches; but a circular Pediment, can only crown agreeably.

There should never be us'd more than two Tympana over each other in the same Frontif-

piece; and even where there are two, it would be proper to have the lower circular, and the upper, pointed.

PEDESTAL [in *Architecture*] is the lowest Part of an Order of Columns; being that which sustains the Column and serves it as a Foot or Stand.

The Pedestal which the *Greeks* call *Stylobates* and *Stereobates*, consist of three principal Parts, viz. a Square, Trunk, or Die, which makes the Body; a Corniche, the Head; and a Base the Foot of the Pedestal.

The Pedestal is properly an Appendage to a Column, not an essential Part of it; tho' M. *Le Clerc* thinks it is essential to a compleat Order.

There are as many kind of Pedestals, as there are of Orders of Columns, viz. 5. The *Tuscan*, *Doric*, *Ionick*, *Corinthian* and *Composite*.

Some say the Height of the Pedestal in each Order, ought to be a third Part of the whole Column, comprehending the Base and Capital, and their upper Adjuncts as Architrave, Frieze and Corniche, a fourth Part of the same Pillar.

The famous English Architect, Sir *Henry Wootton* says, he finds this Rule of singular Use and Facility, settled by *Jacobo Baroccio*, whom he esteems a more credible Author than others (as a Man that most intended this Piece of Architecture) than any that vary from them in these Dimensions.

Indeed *Vignola* and most of the

the Moderns make the Pedestal and its Ornaments in all the Orders, one third of the Height of the Column, including the Base and Capital, but some deviate from this Rule.

M. *Perrault* indeed, makes the Proportions of the three constituent Parts of *Pedestals*, the same in all the Orders, viz. the Base or Socle one fourth of the *Pedestal*, the Corniche an eighth Part, and the Socle or Plinth of the Base, two thirds of the Base it self. The Height of the Die, is what remains of the whole Height of the *Pedestal*.

Tuscan Pedestal (according to *Vitruvius*) the whole Height of the *Tuscan* Column comprehending the Architrave Frieze and Cornice is divided into Nine Parts, two of which go to the Height of the *Pedestal*.

This Pedestal is by him describ'd in two different *Forms*, one of which is plain, having only a Plinth for the Base, and another for the Capital; the Height of each of those Plinths is $\frac{1}{6}$ of the whole Height of the Pedestal, and the Projecture of these Plinths is $\frac{1}{6}$ of their Height.

In the *Pedestal* that he describes, of the other Form he also divides the whole Height of the Pedestal into six Parts, one of which goes to the Base, and one to the Capital.

And again he divides the Base into two Parts, one of which goes to the Plinth below, and the other to the Rest of the Base; this is also subdivided into four Parts, and three of them

goes to the *scima reversa*, and the List below it which is $\frac{1}{2}$ a Part, and the other to the List above it.

Palladio and *Scamozzi* make the *Tuscan Pedestal* three Modules high; *Vignola* Five.

Its Members in *Vignola* are only a *Plinth* for a Base, the *Die*, and a *Talon* crowned for a Corniche; the *Tuscan* Column has rarely any.

The *Dorick Pedestal*. *Vitruvius* divides the whole of this Column (comprehending the Architrave, Frieze and Corniche) into eight Parts, two of which go to the Height of the Pedestal, which agrees with *Jacobo Baroccio's* Rule.

Vitruvius also describes this Pedestal in two different Forms; in both of which, the Base and Capital are each $\frac{1}{4}$ of the whole Height of the *Pedestal*.

He divides the Base of one of the fashioned Pedestals into two Parts, one of which goes to the Plinth below, and the other to the rest of the Base: and this Part being again subdivided into two Parts, one of them makes the lower *Thorus*; and the other is subdivided again into three Parts, two of which go to the upper *Thorus*, and the other to the List above it.

The *Capital* of the *Pedestal* of this Fashion is divided into 4 Parts, the lowermost of which makes the *Astragal* (whose List is $\frac{1}{2}$ of the whole *Astragal*, and the other three Parts go to the *Cymatium*, the List of which at the Top, is one of these Parts.

The Height of the Base of the Pedestal of the other Fashion is

is also divided into two Parts, the lowermost of which goes to the Plinth, and the other Part being again sub-divided into three Parts, two of them make the *Thorus*, and the other Part of the List above it.

The whole Height of the Capital of the Pedestal of this Fashion is divided into five Parts, the lowermost of which goes to the *Astragal*. (Whose List is $\frac{1}{2}$ of the whole,) the next two Parts go to the *Ogee*, and the two Parts that remain are sub-divided into three Parts, the lowermost of which go to the Square, and the other to the *Cymatium*, whose List is $\frac{1}{2}$ of the whole.

Palladio makes the *Dorick Pedestal* four Modules five Minutes high, *Vignola* 5 Modules four Minutes.

In the Antique, we not only dont meet with any Pedestal; but even not with any Base in the *Dorick Order*.

The Members of *Vignola's Dorick Pedestal* are the same with those of the *Tuscan*, with the Addition of a Mouchette in its Corniche.

The *Ionic Pedestal*. The whole Height of this Column being divided into fourteen Parts, the Height of its Pedestal (according to *Vitruvius*) is three of these Parts.

He also describes this Pedestal in two different Forms, the Base and Capital of each of which are each $\frac{1}{2}$ of the whole Height of the Pedestal.

He divides the Height of the Base of one of these fashioned Pedestals, into three Parts, the

lowermost of which goes to the *Plinth*, the next to the *scima reversa*, with its List at Top and Bottom, which are each $\frac{1}{2}$ of the whole; the uppermost Grand Division being sub-divided into two, the lowermost of them goes to the *Casement* or *Hollow*, with its List at the Top, which is $\frac{1}{2}$ of the whole: The other Part goes to the *Thorus*: And its List above it, which List is $\frac{1}{2}$ of the whole. The Capital of the Pedestal of this Fashion is divided into two Parts, the lowermost of which goes to the *scima reversa*, with its List above and below it: The lower List is $\frac{1}{4}$ of the whole, and the upper List $\frac{1}{2}$ of the Remainder. The other Grand Division being sub-divided into three Parts, the two lowermost of them go to the Square, and the other to the *Cymatium*, the List of which is $\frac{1}{2}$ Part of the whole *Cymatium*.

In the Pedestal of the other Fashion, the Base is also divided into three Parts, the lowermost of which goes to the Plinth, the other two Grand Divisions are again divided into Five, and the three lowermost of them go to the *scima reversa*, and the List under it, which List is $\frac{2}{5}$ of the whole; the other two Divisions are again sub-divided into three Parts, the two Lowermost of which go to the *Thorus*, and the remaining Part to the List above it.

The *Capital* of the Pedestal of this Fashion is divided into two Parts, the lowermost of which being sub-divided into four Parts, the lowermost of them

them goes to the Astragal (of which its Lift is $\frac{1}{3}$ Part) the other three of those sub-divisions go to the *scima reversa*, and its Lift above it, which Lift is $\frac{1}{6}$ of the whole; the other Grand Division is also subdivided into three Parts, the two lowermost of which go to the Square, and the other Part to the Astragal whose Lift is $\frac{1}{3}$ of the whole.

According to *Vignola* and *Serlio*, the *Ionic* Pedestal is six Modules high; according to *Scamozzi*, Five; in the Temple of *Fortuna Virilis*, it is seven Modules twelve Minutes.

Its Members and Ornaments are mostly the same with those of the *Doric*, only a little richer.

The Pedestal now usually follow'd is, that of *Vitruvius*, altho' it is not found in any Work of the Antique.

Some, instead of it, use the *Attick* Base in Imitation of the Antients.

The Corinthian Pedestal. *Vitruvius* divides the whole Height of this Column into Nine Parts, and makes the Height of this Pedestal two of those Parts.

The whole Height of the Base being divided into five Parts, the two lowermost of them go to the *Plinth*; then the Remainder is again subdivided into four Parts; the lowermost of which goes to the *Thorus*; and the two next Parts make the *scima reversa*, and the Lift below it, which Lift is $\frac{1}{3}$ of the whole; the remaining Part goes to the Astragal, the Lift of which is $\frac{1}{3}$ Part.

The Height of the Capital is

divided into two Parts, the lowermost of which being subdivided into four Parts, the lowermost of those go to the *Ogee*. The other three Subdivisions being again subdivided into two Parts, the lowermost of those goes to the *Scotia* or *Hollow*, and the Lift above it, which Lift is $\frac{1}{3}$ Part of the whole, and the remaining Part goes to the *Boulin*.

The other Grand Division is also subdivided into three Parts, of which the two lowermost go to the *Corona*, and the remaining Part to the *Cymatium*, the Lift of which is $\frac{1}{3}$ of the whole.

The Corinthian Pedestal is the richest and most delicate. In *Vignola*, it is seven Modules high; in *Palladio* five Modules one Minute. *Vignola* makes it seven Modules high; in *Palladio* five Modules one Minute; *Serlio* six Modules fifteen Minutes: it is in the *Coliseum*, four Modules two Minutes.

Its Members, according to *Vignola*, are as follows; in the Base are a *Plinth* for a *Socle*, over that a *Tore* carv'd; then a *Reglet*. A *Gula* inverted and enrich'd; and an *Astragal*.

In the *Die* are a *Reglet*, with the *Conge* over it, and near the *Corniche* a *Reglet* with a *Conge* underneath.

In the *Corniche* is an *Astragal*, a *Frieze*, *Fillet*, *Astragal* Gorge, *Talon* and a *Fillet*.

The Composite Pedestal. *Vitruvius* divides the whole Height of this Column into thirteen Parts, making the Height of its Pedestal three of those Parts.

The Base he divides into 7 Parts, two of which go to the *Plinth*, one to the *Thor*us, two to the *scima reversa*, one to the *Scotia*, and one to the *Astragal*; $\frac{2}{3}$ of the *Astragal* makes the *Fillet* above the *Scotia*.

The Capital he divides into seven Parts, one of which goes to the *Astragal*, two to the *Frieze*, one to the *Boultine*, and List under it; two to the *Corona*, and one to the *Cymatium*.

Vignola makes the *Composite Pedestal* of the same Height with the *Corinthian*; viz. seven Modules, *Scammozzi* fix Modules 2 Minutes; *Palladio* fix Modules seven Minutes. In the Gold-Smith's Archs, seven Module eight Minutes.

Its Members in *Vignola* are the same with those of the *Corinthian*; but with this Difference, that whereas there are most of them enrich'd with Carvings in the *Corinthian*, they are all plain in the *Composite*.

And there is also a Difference in the Profiles of the Base and Corniche in the two Orders.

Daviler observes, that the Generality of Architects use Tables or Pannels either in *Relievo* or *Creux*, in the Dies of Pedestals; without any Regard to the Character of the Order.

Those in *Relievo*, he observes, are only suitable to the *Tuscan* and *Doric*; the three others must be indent'd, which he says, is a Thing the Ancients never practis'd, as being contrary to the Rules of Solidity.

PEDESTAL of the *Ionie* Order. The Height of this Pedestal, according to this general Rule already propos'd, should be one third of the Shaft of the Column; that is it should exceed 4 Modules 20 Minutes: Yet M. *Le Clerc* says he makes it five Minutes more; without which, in his Opinion, it would lose all its Beauty; whence says he, it may be observ'd, that general Rules are not always to be rigidly follow'd.

The Breadth of the Pedestal he means that of the Die, is always, he says, equal to the Breadth of the Plinth of the Column; excepting the Pedestal be without Base and Corniche, as it frequently happens. In which Case it is necessary that it should be a small Matter broader, in Order to distinguish it from the Base of the Column.

He usually allows one Module for the Height of the Base of the Pedestal, and half a Module for that of the Corniche; the Breadth of the Plinth of the Column, always determines that of the Die of the Pedestal; and a third of the Height of the Column, is the Measure for the whole Height of the Pedestal; so that the Difference in Height, between the Pedestals of his Orders, lies wholly in their Dies.

M. *Le Clerc*, proposes two kinds of Cornices for the *Pedestal* of the *Ionie* Order; the one canvas and solid, to be us'd within Sides of Apartments, where the Pedestal is to be view'd

view'd from above : The other has a Larmier, and is intended for those Pedestals, whose Cornices are above the Eye, and are to be view'd from below.

He observes, that were an *Astragal* to be plac'd underneath the Cornice of the Pedestal, he gives in his 41 Figure, as is done in that of his *Corinthian*, there should be no Table in the Die; at least if for any particular Reason there were requir'd one, there must be no *Astragal*.

Nor would I, says he, ever allow an *Astragal* under a Cornice, that is camus, and without a Larmier, but a Table hollow'd in the Manner of half this Pedestal.

A Table under the *Astragal* would make too many little Mouldings one over another; and the Projecture of an *Astragal* under a Cornice without a Larmier, would make it appear too camus; whereas the Retreat of a Table will give it a Grace, and seem to augment its Projecture, and render it less camus.

When Columns are to be plac'd two by two, as it is sometimes found necessary, the regular placing of the Triglyphs in the inner Angle must be a little interrupted, in Order to keep up the Regularity of the Parts of the Ceiling, and instead of a little Part of a Triglyph in the Angle, may be plac'd some suitable Ornament to cover the Defect, as the Arms of a Family, &c.

Square PEDESTAL, is one whose Height and Width are

equal; as that of the Arch of the Lions at *Verona*, of the *Corinthian* Order; and such some Followers of *Vitruvius*, as *Serlio*, *Philander*, &c. have given to their *Tuscan* Orders.

Double PEDESTAL, is that which supports two Columns, and has more Breadth than Height.

Continued PEDESTAL, is one which supports a Row of Columns without any Break or Interruption; as those are which sustain the fluted Columns of the Palace of the *Tuilleries*, on the Garden Side.

PEDESTALS of Statues, are such as serve to support Statues or Figures.

Vignola has observ'd, that there is no Part of Architecture more Arbitrary, and in which more Liberty may be taken, than in the Pedestals of Statues; there being no Rules or Laws prescrib'd by Antiquity, nor any settled, even by the Moderns.

There is no settled Proportion for these *Pedestals*; but the Height depends on the Situation and the Figure that they sustain; but yet when on the Ground, the *Pedestal* is usually two thirds, or two fifths of that of the Statue; but the more massive the Statue is, the stronger the Pedestal must be.

Their Form and Character, &c. are to be extraordinary and ingenious, far from the Regularity and Simplicity of the Pedestals of Columns.

The same Author gives a great Variety of Forms, Oval, Triangular, Multangular, &c.

PEDIMENTS, says M. *Le Clerc*, are the Crowning frequently seen over Gates, Doors, Windows and Niches, and sometimes over intire Orders of Architecture. The Ridges of ordinary Houses were what gave Architects the first Idea of this noble Part.

The Parts of the Pediment are the *Tympanum* and its *Corniche*.

By *Tympanum* is meant the Area or Space included between the Cornice which crowns it, and the Entablature which supports and serves it as a Foundation.

The *Tympanum* is either triangular or circular; the Triangular, the Workmen call Pointed, and the Circular, Arch'd.

He observes, that the naked of a Pediment, *i. e.* the *Tympanum*, ought always to stand perpendicularly over the Frieze of the Entablature underneath.

2. That the Modillions of the Cornice of the Pediment ought to be found in the same Perpendicular, with those of the Entablature underneath.

3. That Part of the Corniche on which the Pediment stands, beginning just at the Angle of the Corniche, as one would imagine it should, it would be considerably widen'd, by Reason that that Angle is acute. But this would be a considerable Eye Sore; both on Account of the Inequality of its Width, and because it would be rendred too strong and heavy for the Corona.

Some Architects, to reduce this Cymatium to a proper

Width, make the horizontal Cymatium that supports the two Sides of the Pediment very flat; but this is to prevent one Deformity, by putting another in its Stead.

Other Architects make a little Retreat or Elbow, as the Workmen call it, at the Extremity of the *Cymatium* of the Pediment; which Expedient, he thinks, is preferable to any of the rest.

Sometimes the Pediment does not commence from the Extremity of the Corniche; but in that Case too there are Difficulties.

Vitruvius observes, that the Ancients did not approve of Modillions in the Corniche of a Pediment; and the Reason they gave for it was, that Modillions being only intended to represent the Ends of Rafters, it would be absurd to use them in the Declivity of a Pediment, where no Rafters are suppos'd to be.

But the Truth in those Modillions are rather Ornaments to sustain the great Projecture of the *Corona* or *Larmier*, than to represent the Ends of any Rafters or Pieces of Wood; and therefore it would be a Weakness to be influenc'd by such imaginary Reasons; the rather, because these Ornaments have a very good Effect, especially when us'd in large Pediments.

M. *Le Clerc* observes, that a triangular Pediment may serve to crown three Arches, but a circular Pediment can't properly crown more than one; and

and the Centre of the Sweep of the Gate or Arch, should be us'd for describing the Sweep of the Pediment.

He would not have more than two Pediments plac'd over each other in the same Front of a Building; and even where there are two, it would not be amiss to have the one with a Sweep, and the other pointed or triangular; this last finishing the Front in manner of a Ridge.

He also observes, that now we use none of those broken and interrupted Pediments, which *Michael Angelo* introduc'd in his Time; nor is there any Body that seems to value them, but People of no Taste or Experience.

Those made of latter Days, and which are supported by an Entablature, truncated in the middle, as those in the Court of the *Val de Grace*, were so maim'd to shew the Cypher of the House. But these are also Corruptions in Architecture, which ought by all Means to be avoided.

He also observes, that tho' the Pediment is bounded by its *Tympanum* and its *Cornices*, yet were it not for its Entablature underneath, it would not only be ill supported, but imperfect too; just as a Ridge would be, if the Rafters that compose it, wanted Beams, to prevent their flying asunder.

The placing of two Pediments over one another, as is done in the old *Louvre*, is perfectly absurd and ridiculous, tho' perform'd by an Architect of Reputation.

In some Places we likewise see the Architrave interrupted and cut off between the two Columns with Festoons in its Place, which is a Deformity, tho' somewhat less considerable than the former.

He also remarks, that *Vitruvius* thinks it just, that all the Parts rais'd above Columns and Pilasters, that is, all that are above the Eye, as the Faces of the *Architrave*, the *Frieze* the *Tympanum* of the *Pediment*, the *Acroteria* with their Figures or Statues, should be inclin'd forward, about a twelfth Part of their Height. And his Reason for it is, that those Parts will by that Means be the better expos'd to the View of such Persons who are plac'd below; but he thinks his Advice ought here to be set aside, as being built on a particular Reason, to the Prejudice of a general Rule, which enjoins all the Parts of a beautiful Building to be exactly perpendicular.

Without this, he says, they must needs have a woful Effect, when view'd Sideways; on which they would appear Reeling, and ready to tumble down.

However, Statuaries observe *Vitruvius's* Maxims very judiciously, with respect to their Figures, when they are plac'd sufficiently high, and can only be view'd in Front, and from below.

PEER? [in *Building*] is a PIER } massive of Stone, &c. oppos'd by Way of Fortrefs against the Force of the Sea, or a great River; for the Security of Ships that lie at

Harbour in any Haven, as *Dover Peer*, the *Peer* at great *Tarmouth*, &c.

PEERS [in *Architecture*] are a kind of Pilasters or Buttresses, rais'd for Support, Strength, and sometimes for Ornament.

Peers, are a Sort of square Pillars, part of which is hid within the Wall; the only Thing wherein it differs from a Pilaster, being this, that the latter has a Base and Capital, which the former has not.

The Scantlings or Size of Peers.] The Scantlings of Stone Peers, set down by Act of Parliament for the rebuilding of the City of *London*, after the Fire in 1166, (which Scantlings were well consider'd by able Workmen, before they were reduc'd into an Act) to be as follows, viz. in the first Sort of Houses, *Corner Peers* 18 Inches square; *middle* and *single Peers*, 12 and 14 Inches; *Double Peers* between House and House, 14 and 18 Inches. In the second and third Sort of Houses, *Corner Peers* 2 Foot 6 Inches square; *middle* or *single Peers*, 18 Inches square; *Double Peers* between House and House, 14 and 19 Inches square.

The Price.] Peers are sometimes measured and rated by the Foot running Measure; but they are more commonly rated at so much *per Piece*, dearer or cheaper, according to their Size, Goodness of the Stuff, and Curiosity of Workmanship.

A Pair of Stone Peers with Seat Arches, four or five Foot

wide, and 14 or 16 Foot high, may be worth 40 or 50 Pounds.

A Pair of Rustick Peers of Stone, may be worth 12 or 15 Pounds, according to their Height and Substance.

Plain Peers, 8 or 10 Pounds; revail'd and Pilaster Peers, from 12 to 14 Pounds a Pair.

PELLICOIDES [in *Geometry*] a Figure in Form of a Hatchet.

PENDENTIVE [in *Architecture*] the whole Body of a Vault, suspended out of the perpendicular of the Walls and Bearing against the Arc-Boutants.

Daviler describes it as the Portion of a Vault between the Arches of a Dome, usually enrich'd with Sculpture; and *Felibien* takes it for the Plain of a Vault, contain'd between the Double Arches, the forming Arches and the Ogives.

The *Pendentives* are usually of Brick or soft Stone, but Care is to be taken that the Couches or Beds of Masonry be always laid Level and in right Line, proceeding from the Sweep whence the Rise was taken, the Joints too must be made as small as possible, to save the Necessity of filling them up with Wood, or of using much Mortar.

PENDULUM [in *Mechanicks*] is any heavy Body so suspended, as that it may Vibrate or Swing backwards and forwards about some fixt Point, by the Force of Gravity.

PENTADORON, a kind of Bricks so call'd, See *Bricks*.

PENTAGON [in *Geometry*]

a Figure with five Sides and five Angles.

PENTANGLE [in *Geometry*] a Figure having five Angles.

PENTASTYLE [in *Architecture*] a Building having five Rows of Columns.

Such was the Portico begun by the Emperor *Gallian*, and which was to have been continued from the *Flaminian Gate* to the Bridge *Milvius*, i. e. from the *Porto del Popolo*, to the *Ponte-mole*.

PERIDROME [in the ancient *Architecture*] the Space, Gallery, Alley or the like in a *Periptere* between the Columns and the Walls.

PERIPHERY [in *Geometry*] is the circumference or bounding Line of a Circle, Ellipsis, Parabola and similar Figures.

The Periphery of every Circle is supposed to be divided into three hundred and sixty Degrees, which are again subdivided each into sixty Minutes, the Minutes into Seconds, &c.

PERIPTERE [in the ancient *Architecture*] a Building encompass'd on the Out-side with a Series of insulated Columns forming a kind of Isle all around.

Such were the *Basilick* of *Antonine*, the *Septizon* of *Severus*, the *Portico* of *Pompey*, &c.

The *Peripteres* were properly Temples, which had Columns on all the four Sides, by which they were distinguish'd from the *Prostyle* and *Amphiprostyle*, the one of which had no Columns before, and the other none on the Sides.

M. Perrault observes, that *Periptere*, in the general Sense, is the Name of a Genus including all the Species of Temples, which have Portico's of Columns all around; whether the Column be *Diptere* or *Pseudo-Diptere*, or simply *Periptere*, which is a Species that bears the Name of a Genus, and which has its Columns distant from the Wall, by the Breadth of an *Intercolumniation*.

PERITROCHIUM [in *Mechanicks*] as *Axis* in *Peritrochio* is one of the six Mechanical Powers, or simple Machines contrived for the raising of Weights,

PERFECT Numbers, are such whose aliquot or even Parts joined together will exactly return the whole Number as 6 and 28, &c. For of 6 the half is 3, the third Part 2, and the sixth Part one; which added together, make 6, and it hath no more aliquot Parts in the whole Numbers; so 28, which has these Parts 14, 7, 4, 2 and 1 exactly return 28, which therefore is a perfect Number, whereof there are but 10 between 1 and 1000000000.

PERPENDICULAR [in *Geometry*] is a Line falling directly on another Line, or so as to make equal Angles on each Side call'd also a *normal Line*.

From the very Notion of Perpendiculars, it follows,

1. That Perpendicularity is mutual, i. e. if a Line be perpendicular to another, that other is also Perpendicular to the First.

2. That only one Perpendicular can be drawn from one Point in the same Place.

3. That if a Perpendicular be continued through the Line it was drawn Perpendicular to, the Continuation will be Perpendicular to the same.

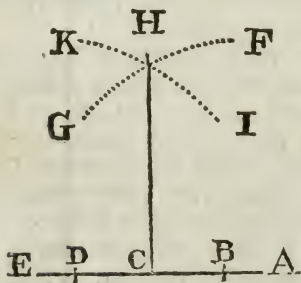
4. That if there be 2 Points of a Right Line, each of which is at an equal Distance from 2 Points of another Right Line, that Line is Perpendicular to the other.

5. That a Line which is *Perpendicular* to another, is alio Perpendicular to all the Parallels of the other.

6. That a Perpendicular Line is the shortest of all those which can be drawn from the same Point to the same Right Line.

Hence the Distance of a Point from a Line, is a Right Line drawn from the Point *Perpendicular* to the Line or Plane; and hence the Altitude of a Figure is a *Perpendicular* let fall from the Vertex to the Base.

To erect the Perpendicular H, G, in or near the middle of the Right Line, A.

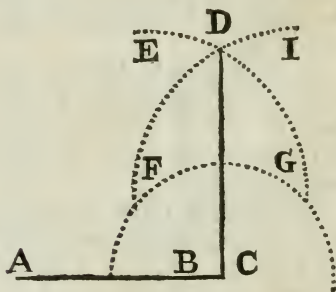


From the Point C set off any equal Distances to B and D,

then with any opening Greater than B C, on the Points B and D describe the Arches F G, and I K intersecting each other in H.

2d, Draw the Right Line H C, and it is the Perpendicular required.

To erect the Perpendicular C D, from C the End of the the Right Line, A C.

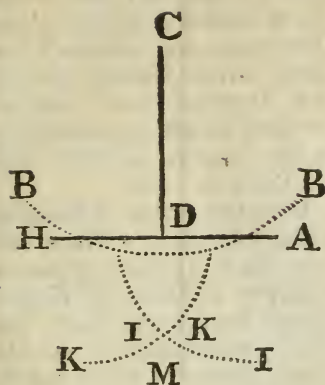


First, On C with any Opening of the Compasses describe the Arch B F G H, and let the Opening as G B, from B to F, and from F to G; then iwth the same, or a greater Opening of the Compasses on the Points F and G describe Arches as F I, and G E, intersecting in D.

2d, Draw the Right Line D, C, and 'tis the Perpendicular requir'd.

To let Fall the *Perpendicular* from the given Point C on the Right Line A, H.

First, with an Opening of the Compasses, greater than C, D, describe an Arch as B, B, intersecting the Right Line A, H, in the Points G and N.



2d, With the Distance G N on G and N, describe the Arches II and K K, intersecting each other in M; then Draw the Right Line C M, and C D will be the Perpendicular let Fall, as requir'd.

PERPENDICULAR to a *Parabola*, is a Right Line cutting the Parabola, in the Point in which any other Right Line touches it, and is also it self *Perpendicular* to that Tangent.

A Line is said to be *Perpendicular* to a Plane, when it is *Perpendicular* to all the Lines it meets with in that Plain: and a Plane is *Perpendicular* to another Plane, when a Line in one Plane is *Perpendicular* to the other Plane.

PERRON [in *Architecture*] is a Stair-case lying open, or on the Outside of the Building: properly the Steps in the Front of a Building, or raised before the Doors of great Houses, which lead into the first Story, when raised a little above the Level of the Ground.

Perrons are made of different

Forms and Sizes, according to the Space and Height they are to lead to.

Sometimes the Steps are Round and Oval; but more commonly Square.

PERRON, according to M. *Le Clerc*, is an Ascent or Elevation given to the Elevation of a Building.

The Portail or Frontispiece of a Church, Palace or any other great Building, should always have a Rise of some Steps, that is in a Word, it ought to have a *Perron*.

The Rest or Landing Place of a *Perron*, should always be extended in width as far as the Frontispiece, if possible; and the Steps, according to *Virruvius*, must always be an odd Number.

These Steps should always be five or six Inches in Height, and ten or twelve Inches in Breadth; that is, their Breadth must be Double their Height; which is found the best Proportion, to have an easy and common Ascent.

Where a *Perron* is thirteen or fifteen Steps high; 'tis necessary, at least 'tis Convenient, to interrupt its Range with one or two Landing Places, that there mayn't be too many Steps to Mount successively, and that the Eye may not be displeated in Ascending so great a Height without Rests.

A *Perron* should always be confined to the Height of the *Zocle* or Foot of the whole Building.

But tho' this *Zocle* or Foot serve as a continued Pedestal, yet

yet it must neither have a Base nor Corniche, when its Height is taken up by a *Perron*; and *M. Le Clerc* says he cannot agree with *Palladio*, in the Examples he has given to the contrary.

PERSIAN ORDER } [in
PERSIC ORDER } *Architecture*] is an Order of Columns which has the Figures of *Persian* Slaves to support the Entablement instead of Columns, as the *Caryatic* Order has the Figures of Women for the same Purpose.

This Order was first used by the *Athenians*, on Occasion of a Victory obtain'd over the *Persians* by their General *Pausanias*, as a *Trophy* of this Victory, The Figures of Men dress'd according to the *Persian* Mode, with their Hands bound before them, and other Characters of Slavery, were charg'd with the Weight of *Doric* Entablatures, and made to do the Office of *Doric* Columns.

M. Le Clerc, says, that *Persian* Columns are not always made with the Marks of Slavery, but are frequently used as Symbols of Virtues and Vices, of Joy, Strength, Valour, &c. and even of Fabulous Deities made in the Figure of *Hercules*, to signify Strength; of *Mars*, to represent Valour; of *Mercury*, to represent Dexterity; and of Fauns or Saytrs, &c. to inspire Mirth and Jollity.

PERSPECTIVE, is an Art which teaches us the Manner of Delineating by Mathematical Rules; it shews us how to Draw Geometrically

upon a Plane, the Representations of Objects according to their Dimensions, and different Situations, in such Manner, that the said Representations produce the same Effects upon our Eyes, as the Objects, whereof they are Pictures. Or

It is the Art of delineating visible Objects on a Plane Surface, such as they appear at a given Distance or Height, upon a transparent Plane, placed Perpendicular to the Horizon, between the Eye and the Object.

This is called particularly *linear Perspective*, as respecting the Position, Magnitude, Form, &c. of the several Lines or Contours of Objects, and expressing their diminution: this is oppos'd to *aerial Perspective*.

Aerial Perspective has Regard to the Colour, Lustre, Strength, Boldness, &c. of distant Objects, considered as seen through a Column of Air, and expresses the delineation thereof.

Perspective is employ'd either in representing the *Ichonographies*, or Ground Plats of Objects, as projected on Perspective Planes, or in *Scenographies*, or Representations of the Bodies themselves.

The General Laws of each are subjoined; in Order to which it is necessary to premise the following *Lemmas* in *Perspective*.

1. That the Appearance of a Right Line, is ever a Right Line; whence the two Extremes being given, the whole Line is given.

2. That if a Line be Perpendicular

Plate XVIII.

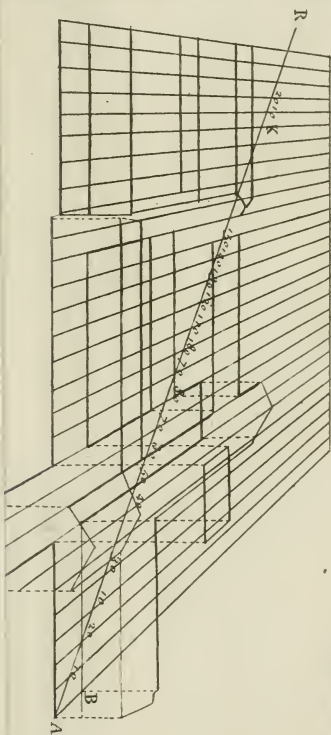
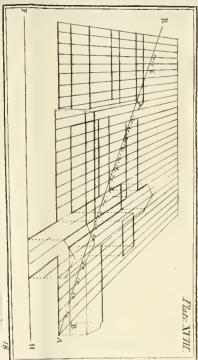


Plate XVII.



cular to any Right Line drawn in a Plane, it will be Perpendicular to every other Right line drawn on the same Plane.

3. That the Height of a point appearing on the Plane, to the Height of the Eye, as the Distance of the objective point from the Plane, to the aggregate of that Distance, and the Distance of the Eye.

PERSPECTIVE of BUILDING, &c.

In the Practice of the *Perspective* of Building, &c. Great Regard must be had to the Height of the horizontal Line, all above the horizontal being seen in the upper Part, and all above it, in the under Part; whence *Perspective* becomes divided into the high and low Sight, both which will be sufficiently illustrated by what follows.

To represent a Building (v. gr. Palace, College, &c.) in Perspective. See the Plate.

1. Take the Ichnography or Ground Plot of the Building; its Length, Breadth, and Depths, by actual measuring, and take its Altitude with a Quadrant.

2. Make a Scale divided into 2 or 300 equal Parts, either actually, or so, as that each Division signifies ten Parts; by this Scale, lay down the Ground Plot.

When you have done this, having a long Ruler and a Square, which by sliding on a Rule, helps to draw your Perpendicular easier, reduce it into *Perspective*, in its Sceno-

graphick Appearance.

Then having drawn a Line towards the Bottom of the Paper, for the Front or Base Lines, as F L, divide it into as many equal Parts, as you find the Building have in the Ichnography, or more if you please. This will serve as a Scale to determine the several Heights, &c. and to these Divisions with a black Lead Pencil, draw Lines from the Centre when you have chosen it; which Choice requires Judgment upon two Accounts.

For if the Centre be too nigh the Front Line, then the Depth of the whole Building will fore-shorten too much; and if too far off, it will not fore-shorten enough.

This may be illustrated thus, Set a Drinking Pot, or the like Vessel on a Stand, so that it be a little lower than your Eye, if you be at a great Distance from it, you can see very little or nothing into it; but if you come nigher to it by Degrees, you will perceive the farther Edge seem to be rais'd a little higher than that next to you, so that you may see a little Way into it; if you come very nigh it, you see deeper into it, and more than can well be express'd in Picture.

You must therefore find some one Place which you conclude the most convenient for the Draught, and which may be in general determin'd to be as far off the Front Line, as the Front Line is long.

This Rule, tho' it has just Grounds, yet we sometimes dispense

dispense with it, *pro re nata*; that we may express Things with the better Appearance.

Consider how to place this Centre with such Advantage, that you may express those Things most, that you chiefly design to do; for as to the Bottom and Top Lines of the Sides of the Building that run from you in or nigh the direct Line to the Centre, tho' the upper Part is seen very well, yet the Sides that fall between the Ground Line and the Top, fall so very near one to the other, that it would be very difficult to express Particulars in them; so that the Centre ought to be well chosen in regard to this.

Therefore those Buildings you would see most of, must be plac'd as far off as you see convenient from the direct Line that runs from the Centre, and the farther they are, the plain-er they are. Then place those Things which you would have least seen, nighest to the direct Line; and observe whether the others fall according to your Mind; but this is to be done after you have drawn your Diagonal, which is the next Thing.

Having pitch'd on your Centre, and having drawn Lines from it to every Division of the Front Line, you must next determine your Diagonal A R, thus: Having measured the Front Line with a Pair of Compasses, set one Foot of the Compasses in the Centre, and take Notice where the other will reach in the Horizon (on

both Sides if you please) and where it rests from that Point, draw a thwart Line from it to the last Division of the Front; and this will be truly drawn, or pretty nigh to the Truth.

That this is so, you may observe how it falls in Respect of the two last Centre Lines; for if you draw a parallel, where the next Line from the last is intersected by the Diagonal, to the Front between them, as at A 10, you will have a *Rhombus*, if then all the Sides be pretty equal, you may be sure you are pretty nigh the right; but if the Sides which run towards the Centre, be too long, then Things will not fore-shorten enough; if the Sides be not long enough, then they will fore-shorten too much.

After you have thus divided the Front Line, fix'd the Centre, and plac'd the Diagonal, take the Breadth of the Chappel A B, which in the Ichnography is shewn to be 20 Parts; because this Line is perpendicular, it must run toward the Centre, therefore reckon 20 in the Diagonal, and the Rule being laid parallel to the Front in that Point, will give you a Point in the Centre Line, which will give the Breadth of the Chappel; and of Consequence, a Line drawn from A to B, puts it into the Ichnographick *Perspective*.

The Length of the Chappel being 70 Divisions in the Front Line, reckon 70 from B, parallel to the Front Line, and there you will have a Point at C.

The Depth of the Building from the Chappel, Northward, being 115 from the Chappel, you are to reckon from D, where it cuts the Diagonal at 50 onwards in the Diagonal, with the Ruler as before, parallel in this Place in the Front, and there is found the Point Z, in the Central Line. The Breadth of it being 30, you reckon three Divisions, and the just Breadth is there, and so on every particular Part.

The Ichnography being thus plac'd into *Perspective*, you may then give every Thing its proper Height, thus

The Height of the Chappel being 30, you are to reckon 30 on the Front Line, and to drop a perpendicular to that Height by a Square clapt to the Front Line; and so where the other Side of the Chappel is plac'd, having reckon'd the Height upon the suppos'd Parallel, and there draw another Line in that Height; then joining these several Heights by several Lines, you will have the Profiles of each Building.

Now to diversify these several Lines, that they may not confound you, make the Ichnography, when you lay it into *Perspective*, in discontinued crooked Lines, the Heights, in prick'd Lines, and the Tops of each Building, in continued Lines, as the Centre Lines are in the Table.

You will also find the Centre, altho' it is not here express'd, as likewise the Point of Distance, by continuing the Diagonal up to the suppos'd

Horizon, where it and the Eye is plac'd.

When these Things are done, you must employ your Art for the particular Expression of Things, by Drawing and Shadowing, which is the Life of this half form'd Figure, which is to be left to the Painter.

The *Low Sight* remains to be spoken of: Here the Horizontal is suppos'd just the Height of the Eye, about five Foot from the Basis; tho' 'tis generally plac'd higher, even to a third Part of the Height of the Building, that the Side Buildings may be express'd more gracefully.

The Diagonal is best determined by dividing the last Division of the Basis Line, into five Parts at G, taking four of these, sometimes the whole five, because it was before determin'd, that the Length of the Front Line, was the Distance of the Eye in the Horizon, to the Point of Distance: but here you are to take four, and then make this the Distance in the Horizon, between the Eye and the Point of Distance.

Then you may either graduate the Plan at the several Intersections of the Diagonal with the Centre Lines, or else suppose it so; and then raise the Building, as you will find by *Perspectives* enough of this Sort every where to be met with.

PERSPECTIVE is also us'd for a kind of Picture or Painting, frequently seen in Gardens, and at the End of Galleries; design'd expressly to deceive

deceive the Sight, by representing the Continuation of an Alley, a Landkip, a Building, or the like.

PERSPECTIVE Plane, is a Glass or other transparent Surface, suppos'd to be plac'd between the Eye and the Object, perpendicular to the Horizon, unless the contrary be expressly mention'd.

PHAROS } a Light House,
PHARE } a Pile rais'd near a Port, in which a Fire is kept burning in the Night, to guide and direct Vessels near at Hand.

PIAZZA [in *Architecture*] popularly call'd *Piache*, an *Italian* Name for a Portico.

It signifies a broad open Place or Square; whence it became apply'd to Walks or Portico's around them.

PIEDOUCH [in *Architecture*] is a little Stand or Pedestal, either long or square, enrich'd with Moulding; serving to support a Bust, or other small Figure.

PIEDROIT [in *Architecture*] is a Peer or a Kind of square Pillar, part of which is hid within a Wall; the only Thing wherein it differs from a Pilaster is, that the Pilaster has a regular Base and Capital, which the Piedroit wants.

PIEDROIT is also us'd to signify a Peer or Jaumb of a Door or Window; comprehending the *Chambrante*, *Chamfering*, *Leaf*, &c.

PILASTER [in *Architecture*] a square Column, sometimes insulated; but more frequently set within a Wall, and

only shewing a fourth or fifth Part of its Thickness.

The Pilaster is different in different Orders, it borrows the Name of each Order, and has the same Proportions, and the same Capitals, Members, and Ornaments with the Columns themselves.

Pilasters are usually without swelling or Diminution, a broad at Top as at the Bottom, tho' some of the modern Architects, as M. *Mansard* &c. diminish them at Top, and even make them swell in the middle, like Columns, especially when plac'd behind Columns.

M. *Perrault* observes that *Pilasters* like Columns, become of different Kinds, according to the different Manner wherein they are apply'd to the Wall.

Some are wholly detach'd, these *Vitruvius* calls *Parastata*; others have three Faces clear out of the Wall; others two; and others only one; all these *Vitruvius* calls *Antæ*.

Insulate Pilasters are but rarely found in the Antique; the chief Use the Ancients made of Pilasters, was at the Extremities of Portico's, to give the greater Strength.

There are four Things to be principally regarded in *Pilasters*, viz. 1. Their Projecture out of the Wall. 2. Their Diminution. 3. The Disposition of the Entablature, when it happens to be common to them, and to a Column, and 4. their Flutings.

1. The *Projecture* of Pilasters,

ters, which have only one Face out of the Wall, ought to be $\frac{1}{3}$ of their Breadth; or at most not above $\frac{2}{5}$.

The Projecture may be a quarter of their Diameter when they receive Imposts against their Sides.

2. *Pilasters* are seldom diminish'd when they have only one Face out of the Wall.

Indeed the *Pilasters* are to have the same Dimensions with the Columns, where they stand in the same Line with Columns and the Entablature is continued over both without Break; that is to say, on the Face respecting the Column; the Sides being left without Diminution.

3. *Pilasters* are sometimes fluted, tho' the Columns that they accompany are not; and on the contrary, the Columns are sometimes fluted, when the *Pilasters* that accompany them, are not.

The Flutings of *Pilasters* are always odd in Number, except in half *Pilasters*, which meet at inward Angles, where four Flutings are made for three, &c.

4. The Proportions of the Capitals of *Pilasters* are the same as to Height with those of Columns; but differ in Breadth, the Leaves of *Pilasters* being much broader, because that *Pilasters* having equal Extent, have only the same Number of Leaves for their Girt, &c. viz. eight.

Their ordinary Disposition is to have two in each Face in the lower Row, and one in the

middle in the upper Row, and two halves in the Angles, in the Turns of which they meet.

To this may be added; that the Run of the Vase or Tambour, is not strait, as the lower Part is; but a little circular and prominent in the middle.

In *Pilasters* which support Arches, *Palladio* shews, that the Proportions must be regulated by the Light they let in; and at Angles, by the Weight they sustain.

Sir *Henry Wootton* tells us, as to their Sight and Situation, that *Pilasters* must not be too tall and slender, least they resemble Pillars; nor too dwarfish and gross, least they imitate Piles or *Peers* of Bridges.

That Smoothness does not so naturally become them as a Rustick Superficies; for they aim more at State and Strength than Elegancy.

That in private Buildings, they ought not to be narrower than $\frac{1}{3}$, nor broader than $\frac{2}{3}$ of the Vacuity, or inter Space, between *Pilaster* and *Pilaster*; but as for those that stand at the Corners, they may have a little more Latitude allow'd them, by Discretion for the Strength of the Angles.

Palladio observes, that in Theatres and Amphitheatres, and such massive Works, they have been as broad as the half, and sometimes as the whole Vacuity or Interspace.

He also takes Notice (and others agree with him) that their true Proportion should be an exact Square, but (for lessening of Expence, and enlarging of

of Room) they are usually made narrower in Flank than in Front.

Their principal Grace consists in half or whole Pillars, apply'd to them, in which Cases, Authors have well observ'd that the Columns may be allow'd Something above their ordinary Length, because they lean to so good Supporters.

As to the Price of *Pilasters*, They are sometimes measured and rated by the Foot running Measure, and valued at so much *per Piece*, according to the Size, Goodness of the Materials, and Curiosity of the Workmanship.

PILASTER *Bricks*, See *Bricks*.

PILASTERS are square Columns, as big at Top as Bottom.

These Pilasters are often us'd for mere Show; as when they appear insert'd or let within the Wall, not discovering above a fifth or sixth Part of their Bigness.

These kinds of Pilasters, which may be call'd flat Pilasters, are always found to have a better Effect than others, which being intire, ordinarily appear heavy and lumpish.

When these Pilasters accompany Columns, they should have the same Heights with the Columns in every Part; but if they be alone, *i. e.* if they be not accompanied with any Columns, their Measures and Proportions should be varied.

First, In the *Roman*, *Spanish* and *Corinthian* Orders, the Ca-

pitals of Pilasters to be well proportioned should be higher than those of Columns, as being broader; whence it follows, that their Shafts ought also to be augmented in Proportion.

Secondly, It may be observ'd in general, that a Pilaster made according to the Measures or Proportions of a Column, that is, containing an equal Number of Modules in Height, appears much shorter with Regard to its Breadth than the Column; and the Reason is that the Sides of the Pilaster being flat, appear in their full Breadth; which is otherwise in the Column, the Shadow of whose Roundness makes it appear slenderer than it really is. So that to make a Pilaster appear with the Beauty of a Column, the Height of its Shaft must be augmented, as well as that of its Capital; and consequently the Height of its Entablature, and that of its Pedestal, must be augmented likewise.

Further, the Capital of Pilaster being broader than that of a Column, and the Profile of the Entablature beyond the naked of the Pilaster, continuing nearly the same, the Modillions are found farther apart from each other, than in the Orders of the Columns, whence it likewise follows that the Distances given for the Interval of Columns adjusted by a certain Number of Modillions won't serve for the Intervals of Pilasters, no more than they will for determining the Proportion of Portico's.

And lastly, the Modillions being farther a-part from each other, the Cornice ought to have a greater Projecture, in Order to have perfect Squares between the Modillions, whereon the Regularity of the Soffit depends.

'Tis necessary therefore, to have particular Compositions for the Orders of Pilasters, distinct from those Columns; for this Reason says M. *Le Clerc* supposes the following ones, which answer to those of his Order of Columns.

Of the Projecture of PILASTERS. He says, the ordinary Projecture of these Pilasters beyond the Wall, is 10 or 12 Minutes, but when they terminate the Salient Angle of a Building, their Thickness, should, if practicable, be regulated by the Parts of the Soffit or Plafond of the Cornice.

When Flutings are us'd in Pilasters, their Number should be seven on each Side; the first and last of which, may be a little further from the Angle, then the Rest are from each other; that the Extremities of the Pilasters, mayn't be too much weakened.

In some old Monuments we find Pilasters which have only five Flutings on a Side; but then those are too large, and make the Pilasters appear little and pitiful, and if there were nine, this would be too fine and slender, even for the most delicate Orders.

He Remarks, that we never make Flutings in the *Tuscan*

Pilaster, and if by Chance we make any in the *Doric* (which however is very rare) we leave pretty large Spaces next to the two Extremities in Order to fortify the Angles.

One may either add a single Fluting in the Projecture or Thickness of the Pilaster, or leave it quite plain, provided it don't exceed ten Minutes.

Pilasters split or cloven from Top to Bottom, M. *Le Clerc* says in an inner Angle, never have a good Effect; for besides that their halves have no Symmetry with the entire Pilasters that answer to them, their Capitals do likewise become very defective, as is particularly seen in the Church of the *Val de Grace*.

When Columns and Pilasters are plac'd under the same Entablature, the Entablature must be that of the Columns.

When Columns and Pilasters are plac'd under the same Entablature, they should never if possible stand in the Front Line, by Reason of the manifest Irregularities that would follow thereupon; they must therefore be separated by a Ressaut or Difference in the Range.

A Ressaut can never consist of less than an entire Modillion, without ruining the Regularity of the Parts of the Soffit or Cornice.

Further, if the *Ressaut* don't exceed a Modillion, the Column will remain engag'd in the Body of the Building.

When Pilasters accompany insulate Columns and serve them as a Ground or *arriere Corps*,

Corps, they ought to be at a competent Distance from each other, to prevent their Capitals from interfering.

When a Pilaster is plac'd behind a Column, the Breadth of the upper Part of its Capital should be reduc'd to that of the upper Part of the Capital of the Column, to the End that their Bases being of the same Breadth, their *Abacus* and *Volutes* may be so too.

PILE [in *Antiquity*] was a Pyramid built of Wood, on which the Bodies of Persons deceased were laid in Order to be burnt.

PILE is also us'd to signify a Mass or Body of Building.

PILES [in *Architecture*] are great Stakes rammed into the Earth to make a Foundation to build upon in marshy Ground.

Amsterdam and some other Cities, are wholly built upon Piles. The Stoppage of *Dagenham* Breach is effected by Dove-Tail Piles mortois'd into one another, by a Dove-Tail Joint.

PILLAGE [in *Architecture*] is sometimes us'd by some Builders, for a square Pillar standing behind a Column to bear up the Arches; having a Base and Capital as a Pillar has.

PILLAR [in *Architecture*] is a kind of irregular Column, round and insulated, deviating from the Proportions of a just Column.

Pillars are always either too massive or too slender for a regular *Architecture*; such are the Pillars which support *Gothic* Vaults or Buildings.

In Effect, *Pillars* are not restrain'd to any Rules; their Parts and Proportions being arbitrary.

PILLARS or PIEDROITS of the *Roman* Order. In Portico's where the Columns have Pedestals, the *Pillars* or *Piedroits* ought to be four Modules in Breadth; but if they be more, M. *Le Clerc* says, they will be ill proportion'd to their Columns; an Instance of which we have in the great *Composite* Portico of *Palladio*; to which it may be added that the Inter-Columns in that Case, would likewise be too big; as may be observ'd in the *Doric* Order of *Vignola*, where the Pillars of his great Portico, being of five Modules, the Columns are found too far distant from one another.

He also remarks, that *Palladio* in the *Roman* Order terminates these Pillars with the Mouldings of the Base of the Pedestal, which he continues quite round, so that the Base of the Pedestal, becomes confounded with that of the *Piedroit*; a Thing, that in his Opinion ought to be avoided.

For if those Mouldings be proportion'd to the Height of the Pedestal, they can't be so to that of the Pillar: Besides, that by advancing a good Way within the Passage, they become incommodious, and are soon broken and defeated.

Vignola terminates these Pillars with a plain Zocle, which here suits very well.

When the Columns have no Pedestals, he terminates the Pillars

Pillars with a Zocle, equal to the Base of the Column.

A *Butting* PILLAR is a Buttress or Body of Masonry, rais'd with a Design to prop or sustain the shooting of a Vault, Arch or other Work.

A *Square* PILLAR, is a massive Work of Masonry, call'd also a *Peer* or *Piedroit*, serving to support Arches, &c.

PINION [in *Mechanicks*] is an Arbor or Spindle, in the Body whereof are several Indentures or Notches, which catch the Teeth of a Wheel, that serves to turn it round, or a *Pinion* is a lesser Wheel, which plays in the Teeth of a larger.

PINNACLE [in *Architecture*] is the Top or Roof of a House, which terminates in a Point.

This Sort of Roof among the Ancients was appropriated to Temples; they making their ordinary Roofs flat, or in the Platform Way.

The *Pediment* is said to have taken its Rise from the Pinnacle.

PINNING [with *Bricklayers*] is the fastening of Tiles together with Heart of Oak, for the Covering of a House, &c. Pinning is said by some *Suffex* Workmen, to be done for 8 d. per 1000, for finding Pins and Pinning of Tiles; but for the Workmanship only 6 d.

PINS for *Tileing*. It is customary to allow two Gallons of Tile Pins to every Thousand of Tiles. These Pins Mr. *Leybourn* says, are in Price from 3 d. to 6 d. the Gallon.

Others say that they use a Gallon of Pins to a square and half of Tileing.

PIPES [in *Building*, &c.] Canals or Conduits for the Conveyance of Water, &c.

Pipes for Water, Water Engines, &c. are usually of *Lead*, *Iron*, *Earth*, or *Wood*; those of Timber, are ordinarily either Oak or Alder.

Iron Pipes are cast in Forges; their Length is about two Foot $\frac{1}{2}$, several of which are pieced together by Means of four Screws at each End, with Leather or old Hat between them to stop the Water.

Earthen Pipes are made by Potters. These are fitted into one another, one End being always made wider than the other. To join them the closer and prevent their leaking, they are covered with Tow and Pitch, Their Length is commonly about two Foot $\frac{1}{2}$.

The wooden Pipes are Trees bored with large Iron Augurs of different Sizes, beginning with a less, and then proceeding with a larger successively; the first being pointed, the Rest form'd like Spoons, increasing in Diameter from one to six Inches: they are fitted into the Extremities of each other; and are sold by the Foot.

Leaden Pipes are of two Sorts, the one soldered, the other not soldered, for the Construction of each Sort, See *Lead* and *Plumbery*.

PISTON is a Part or Member of several Machines, as Pumps, &c.

The *Piston of a Pump*, is a short Cylinder of Metal fitted exactly to the Cavity of the Barrel or Body; and which being work'd up and down alternately in it, raises the Water, and when rais'd, presses it again, so as to cause it to force up a Valve, with which it is furnish'd, and so escape thro' the Nose of the Pump.

PITCH.

PITCH [in *Architecture*] is the Angle, a Gable End, and consequently the whole Roof of a Building.

If the Length of each Rafter be $\frac{3}{4}$ of a Building, the Roof is said to be *True Pitch*.

If the Rafters are longer, 'tis said to be a *high* or *sharp pitch'd* Roof; if shorter, which seldom happens, it is said to be a *low* or *flat pitch'd* Roof.

PITCHING, the same as *Paving*, which see.

PIVOT [in *Building*] is a Foot or Shoe of Iron or other Metal, ordinarily conical or terminating in a Point; by Means of which a Body which is intended to turn round, bears on another, fix'd at Rest, and perform its Turns or Circumvolutions.

Large Gates, &c. usually turn on Pivots. The Ancients relate that they had Theatres in *Rome*, which would contain 80000 People, which yet turned on a single Pivot.

PLACARD [in *Architecture*] is the Decoration of the Door of an Apartment, consisting of a *Chambrante*, crown'd with its *Frieze* or *Gorge*; and its Corniche sometimes supported by Consoles.

PLACE [in *Opticks*] or *Optick PLACE*, is the Point to which the Eye refers an Object.

PLACE *Bricks*, See *Bricks*.

PLAFOND } [in *Architecture*]
PLATFOUND } is the Ceiling of a Room whether it be flat or arch'd; lin'd with Plaister or Joiner's Work, and frequently enrich'd with Painting.

PLAFOND is also more particularly us'd for the Bottom of the Projecture of the *Larmier*, of the Cornice, call'd also the *Soffit*.

PLAIN *Cornice*. See *Cornice*.

PLAIN FIGURE [in *Geometry*] is a Plane Surface, from every Point of whose Perimeter, Right Lines may be drawn to every other Point in the same.

PLAIN *Angle* [in *Geometry*] is an Angle contain'd under two Lines or Surfaces, so call'd in Contra-distinction to a solid Angle.

PLAIN *Triangle* [in *Trigonometry*] is a Triangle included under three Right Lines or Surfaces, in Opposition to a spherical or mixt Angle.

PLAIN *Trigonometry*, is the Doctrine of Plain Triangles, their Measures and Proportion.

PLAIN GLASS *Mirror*, &c. [in *Opticks*] is a Glass or Mirror, whose Surface is flat or even.

PLAIN *Tile*. See *Tile*.

PLAIN SCALE, is a thin Ruler, either of Wood or Brass, whercon are gratuated the Lines of Chords, Sines and Tangents, Leagues, Rhumbs &c. and is of ready Use in most

most Parts of the Mathematicks.

PLAIN *Table*, is an Instrument u's'd in surveying of Land.

1. The Table it self, is a Parallelogram of Wood, 14 Inches and a half long, and about 11 Inches broad.

2. A Frame of Wood fix'd to it, so that a Sheet of Paper being laid on the Table, and the Frame being forc'd down upon it, squeezeeth in all the Edges, and makes it lie firm and even, so that a Plot may be conveniently drawn upon it.

Upon one Side of this Frame should be equal Divisions for drawing Parallel Lines, both long Ways and cross Ways (as Occasion may require) over the Paper; and on the other Side, the 360 Degrees of a Circle, projected from a Brass Centre, conveniently plac'd on the Table.

3. A Box with a Needle and Card, to be fix'd with two Screws to the Table, very useful for placing the Instrument in the same Position upon every remove.

4. A three legg'd Staff to support it; the Head being made so as to fill the Socket of the Table, yet so as the Table may be easily turn'd round upon it, when 'tis fix'd by the Screw.

5. An Index, which is a large Ruler of Wood (or Brass) at the least 16 Inches long, and two Inches broad, and so thick as to make it strong and firm; having a sloped Edge (call'd the fiducial Edge) and

2 Sights of one Height (the one of which has a Slit above and a Thread below) to be set in the Rulers, so as to be perfectly of the same Distance from the fiducial Edge.

Upon this Index it is usual to have many Scales of equal Parts, as also Diagonals and Lines of Chords.

By this Instrument the Draught or Plan is taken upon the Spot, without any future Protraction or Plotting.

PLASTERING, some Workmen in *Suffex* say, that they have for Lathing and Plastering with Lome on both Sides, 3d. per Yard; but with white Lime and Hair Mortar on both Sides, 4d. per Yard.

Some tell us that at *Tunbridge Wells* they will do the Plaistering of Walls (where they plaster over all the Timber) and Ciclings, for 2 s. 10d. per Square; and some say, they have had it done for 2 s. 6d. *Of Plaistering Ceilings.* They have in *Suffex* for Plastering of Ceilings, Lathing and finishing, 4d. per Yard.

And in some Countries, where they make their Plaster of Reed, Lime and Hair, they perform the Workmanship singly for 3d. per Yard; but if the Workmen find all Materials, 'tis worth 5d. or 6d.

Plastering with rough Mortar, call'd Rough Casting. In *Kent* they Rough cast upon old Loam-Walls, that is they give them one Coat upon the Loam of *Rough Cast* or *Rough Mortar*, tho' it be commonly

struck smooth like Lime and Hair, for $3\frac{1}{2}$ d. per Yard, Workmanship only.

But if the Wall be new, and Lathed and Plastered with Loam on both Sides, they have 4 d. per Yard for Workmanship.

But if the Rough Casting be wrought in Flourishes, they have 8 d. per Yard for Workmanship singly; but if the Workman find all Materials, 'tis worth from 1 s. to 2 s. per Yard, according to the Goodness and Variety of the Work.

Of Plastering on Laths, in Imitation of Brick.] For this Sort of Work, the Plaster is made of Powder of Bricks, sharp Sand, Lime and some Red Oker.

Some of this Plastering will look like a Brick Houfe, so as to deceive Passengers passing by, and look well for 20, 30, or 40 Years. This Work is valued at 1 s. per Yard for Workmanship only.

Of Plastered Floors.] Mr. Wing says this Work is worth, (the Workman finding all Materials) 1 s. 4 d. per Yard; but the Workmanship only from 4 d. to 6 d.

Plaster may be had at the Pits for 4 s. or 4 s. 6 d. per Load, or 40 Hundred Weight, which will lay about 40 Yards of Flooring.

Of White Washing.] With Size upon plastered Walls, is usually reckon'd at 2 d. per Yard.

Of Measuring.] This is usually computed by the Yard square, as *Paving* is. See *Pav-*

ing. But you are to take Notice, that in measuring Partitions, if the Workman finds Materials, the Doors and Windows being measured by themselves, are deducted out of the whole; as is also $\frac{1}{2}$ Part of the Rest, for the Quarters in rendering Work.

But if the Workman does not find Materials, he does not commonly make any Allowance for them, the Trouble of cutting and fitting the Laths being accounted equivalent to the void Spaces, left for the Doors and Windows.

Nor is there to be made any Allowance in Case of Workmanship only (in rendering) for the Quarters, Braces, or Inter-ties, the Work being as much (if not more) than if it were all Plain. See *Pargeting*.

The Measuring of PLASTERERS Work.

PLASTERERS Works are chiefly of two Kinds.

1st. Lath'd and Plastered Work, which they call *Ceiling*.

2dly. Render'd Work which is of two Sorts, viz. upon Brick Walls or between Quarters, in the Partitions between Rooms; all which are measured by the Yard Square, or Square of 3 Feet, which is 9 Feet.

1st. *Of Ceiling.* If a Ceiling be 50 Feet, 9 Inches long, and 24 Feet 6 Inches broad, how many Yards are contain'd in that Ceiling?

Multi-

Multiply 59 Feet, by 24 ches, 6 Parts, which divided Feet, 6 Inches, and the Product will be 1463 Feet, 10 In- Yards, 5 Feet.

F.	I.
59	9
24	6
<hr/>	
236	
118	
209	: 10 : 6
18	: 00 : 0
<hr/>	
1463	: 10 : 6

59.75
2415
<hr/>
29875
23900
11950
<hr/>

9) 1463.875
Answer 162 : 5

By Scale and Compaffes.

Extend the Compaffes from 9 to 59 Feet, 9 Inches, and that Extent will reach from 24 Feet, 6 Inches, to 162.5. Yards.

2dly. Of Rendering.

Example. If the Partitions

between Rooms be 141 Feet, 6 Inches about, and 11 Feet 3 Inches high, how many Yards do those Partitions contain?

Multiply 141 Feet 6 Inches, by 11 Feet 3 Inches, and the Product will be 1591 Feet, 10 Inches, 6 Parts; which being divided by 9, will give 176 Yards, 7 Feet, the Answer.

F.	I.
141	6
11	3
<hr/>	
1556	6
35	4 6
<hr/>	
9) 1591	10 6
<hr/>	

Answer 176 : 7 0

141.5

11.25

7075

2830

1415

1415

9) 1591.875

176.87

Answer 176.87 Yards.

By Scale and Compaffes

Extend the Compaffes from 9 to 141.5, and that Extent will reach from 11.25. to 176.87 Yards.

Note 1. If there are any Doors, Windows or the like in the Partitioning, Deductions must be made for them.

Note 2. That when *Rendering* upon Brick-Walls is measured, no Deductions are to be made; but when *Rendering* is measured between Quarters, one fifth Part may be very well deducted for the Quarters, Braces and Interties.

Note 3. Whiting and Colouring are both measured by the Yard, as *Ceiling* and *Rendering* were; and likewise in *Whiting* and *Colouring*, one fourth or at least one fifth Part is to be added; as one fifth Part is deducted in *Rendering* between Quarters.

PLAN } [in *Geometry*] is
PLAIN } a *plain Figure*
PLANE } or Surface, lying evenly betwixt its bounding Lines. It is by *Wolffus* defin'd to be a Surface, from every Point of whose Perimeter, a Right Line may be drawn to every other Point in the same.

As the Right Line is the shortest Extent from one Point to another; so is a *Plane* the shortest Extension between one Line and another.

Geometrical PLANE [in *Perspective*] is a Plane Surface, parallel to the Horizon, plac'd lower than the Eye, in which the visible Objects are imagined without any Alteration, except that they are sometimes reduc'd from a greater to a lesser Size.

Horizontal PLANE [in *Perspective*] is a Plane which is parallel to the Horizon, and which passes thro' the Eye, or hath the Eye suppos'd to be plac'd in it.

PLANE of the Horopter [in *Opticks*] is that which passes through the Horopter, and is perpendicular to the Plane of the optical Axes.

PLANE Numbers, is that which may be produc'd by the Multiplication of two Numbers the one into the other; thus 6 is a Plane Number, because it may be produc'd by the Multiplication of 3 by 2; so likewise 15 is a Plane Number, because it is produc'd by multiplying 5 by 3, and 9 is a Plane Number, produc'd by the Multiplication of 3 by 3.

PLANE PROBLEM [in the *Mathematicks*] is such a one as cannot be solv'd Geometrically; but by the Intersection either of a Right Line and a Circle; or of the Circumference of two Circles; as having the greater Side given, and the Sum of the other two, of a Right angled Triangle, to find the Triangle.

To describe a Trapezium, which shall make a given Area of four given Lines, and such a Right Line can cut a Circle, or one Circle another; but in two Points.

PLANE of Reflection [in *Catoptricks*.] is that which passeth through the Point of Reflection, and is always Perpendicular to the Plane of the Glass or reflecting Body.

PLANE of Refraction, is a Surface drawn through the incident and refracted Ray.

PLANE Surface, is that which lies even between its bounding Lines; and as a Right Line is the shortest Extension

tenſion from one Point to another, ſo a plain Surface is the ſhorteſt Extenſion from one Line to another.

Vertical PLANE, [in *Opticks* &c.] is a Plane Surface which paſſes along the principal Ray, and conſequently through the Eye, and is Perpendicular to the Geometrical Plane.

Horizontal PLANE [in *Mechanicks*] is a Plane level or parallel to the Horizon.

Inclin'd PLANE [in *Mechanicks*] is a Plane which makes an Oblique Angle, with an Horizontal Plain.

PLANE [in *Joinery*, &c.] is an Edg'd Tool or Inſtrument for paring and ſhaving Wood ſmooth, even, &c.

It conſiſts of a Piece of Wood very ſmooth at Bottom, as a Stock or Shaft; in the middle of which is an Aperture, thro' which a Steel Edge or Chiſſel placed Obliquely paſſes, which being very Sharp, takes off the inequalities of the Wood, it is ſlid along.

Planes have various Names according to their various Forms, Sizes and Uſes.

1. The *Fore-PLANE* which is a very long one, and is uſually that which is firſt uſed, the Edge of its Iron, or Chiſſel is not ground Streight; but Riſes with a Convex Arch in the middle, to bear being ſet the ranner: the uſe of it being to take off the greater irregularities of the Stuff, and to prepare it for the ſmoothing Plane.

2. The *ſmoothing PLANE* is ſhort and ſmall, its Chiſſel or Iron being finer; its uſe is to

take off the greater irregularities left by the *Fore-plane*, and to prepare the Wood for the Jointer.

3. The *Jointer* is the longeſt of all; its Edge being very fine, and not ſtanding above a Hair's Breadth: It is uſed after the Smoothing Plane, and is chiefly deſigned for ſhooting the Edge of a Board perfectly ſtrait, for jointing ſmooth Tables, &c.

4. The *Strike Block* is like the Jointer, but ſhorter: Its Uſe is to ſhoot ſhort Joints.

5. The *Rabbet PLANE* is uſ'd in cutting the upper Edge of a Board, ſtrait or ſquare, down into the Stuff, ſo that the Edge of another, cut after the ſame Manner, may join in with it on the Square; it is alſo uſ'd in ſtriking *Facia's* in Mouldings. The Chiſſel or Iron of this Plane is full as broad as its Stock, that the Angle may cut ſtrait, and it delivers its Shavings at the Sides, and not at the Top, like the others.

6. The *Plow*, a narrow Rabbet Plane, with the Addition of two Staves, whereon are Shoulders. The Uſe of it is to plow a narrow ſquare Groove on the Edge of a Board.

7. *Moulding PLANES*; of theſe there are various Kinds, accommodated to the various Forms and Profiles of the Mouldings; as the *round Plane*, the *hollow Plane*, the *Ogee*, the *Snipes Bill*, &c. which are all of ſeveral Sizes, from half an Inch, to an Inch and half.

To use the *Moulding Planes* on soft Wood, as Deal, &c. They set the Iron to an Angle of 45, with the Base or Socle of the Plane. On hard Wood, as Box, &c. they set the Iron to an Angle of 80 Degrees, sometimes quite upright.

To work on hard Wood, the Edge or Basil is ground to an Angle of 18 or 20 Degrees; to work on soft Wood, to an Angle about 12, for the more acute the Basil is, the smoother the Iron will cut; but the more obtruse, the stronger.

PLANIMETRY, is that Part of *Geometry* which considers Lines and Plain Figures; without any Consideration of Heights or Depths.

The Word is particularly restrain'd to the measuring of Planes or Surfaces, in Opposition to *Stereometry*, or the measuring of Solids.

PLANO *Concave Glass* or *Lens*, is that, one of whose Surfaces is Concave, and the other Plain.

The Concavity is here suppos'd to be spherical, unless the contrary be express'd.

PLANO *Convex Glass* or *Lens*, is that, one of whose Surfaces is Convex, and the other Plain.

The Convexity of this is suppos'd to be spherical, unless the Contrary be express'd.

PLASTER & A Composition of Lime sometimes with Hair, sometimes with Sand, &c. for Parageting or Covering over the Nakednesses of a Building.

PLASTER of *Paris*, is a

Fossil Stone, of the Nature of a Lime-Stone, serving to many Purposes in Building, and is also us'd in Sculpture, in moulding and making of Statues, Basso Relievo's, and other Decorations in Architecture.

It is dug out of Quarries, in several Places near *Paris*, whence it takes its Name; the finest of it is that of *Montmartre*.

Crude PLASTER of *Paris*, is the Native as it comes out of the Quarry, in which State it is us'd, as Hards in the Foundation of Buildings.

Burnt PLASTER is the Native calcin'd like Lime in a Kiln or Furnace, pulveriz'd or diluted with Water or other Liquid in working it. In this State it is us'd as Mortar or Cement in Building.

It being well sifted and reduc'd to an impalpable Powder, it is us'd in making Figures in Sculpture.

PLASTICE or *Plastic Art*, a Branch of Sculpture, being the Art of forming Figures of Men and other Animals, in Plaster, Clay, Stuc, &c.

It is not only comprehended under Sculpture, but is indeed Sculpture it self; but with this Difference, that the Plasterer or *Plasteer* (by his *Plastic Art*) makes Figures by Additions, but the Carver by Subtraction, whereupon *Michael Angelo* was wont to say (pleasantly) that Sculpture was nothing but a Purgation of Superfluities; for take away from a Piece of Wood or Stone, all that is superfluous, and the Remainder is the intended Figure.

The

The *Plastic Art* is now chiefly us'd among us in Fret-Work Ceilings; but the *Italians* apply it to the Mantlings of Chimneys with great Figures, a cheap Piece of Magnificence, and almost as durable within Doors, as harder Forms in the Weather.

PLAT-BAND [in *Architecture*] says M. Perrault is any flat square Moulding, having less Projecture than Height; such are the Faces or Fasciæ of an Architrave, and the *Plat-Bands* of the Modillions of a Cornice.

These *Plat-Bands* are ordinarily cross'd with Bars of Iron, when they have a great *Bearing*; but it is much better to ease them by Arches of Discharge built over them.

PLAT-BANDS of *Flutings* are the Lists or Fillets between the Flutings of the *Ionic*, *Corinthian* and *Composite* Columns, they are each in Breadth $\frac{1}{4}$ of the Flute.

Plat-Bands are also a square Moulding, set at the End of the Architrave of the *Doric* Order.

The *Plat-Band* is signified by *Vitruvius* by the Words, *Fascia*, *Tenia* and *Corfa*.

PLAT-FORM [in *Architecture*] is a Row of Beams which support the Timber Work of a Roof, and lie on the Top of the Wall, where the Entablature ought to be rais'd.

The Term is also us'd for a kind of Terras Walk or even Floor on the Top of a Building; from whence we may take

a fair Prospect of the adjacent Country.

So an Edifice is said to be cover'd with a Platform when it is flat at Top, and has no arched Roof or Ridge.

Platform is sometimes us'd to signify the Ichnography or Draught of the Ground-Plot of an House.

Most of the Eastern Buildings are covered with *Platforms*, as also were those of the Ancients. *Cesar* is said to have been the first among the *Romans* who obtain'd leave to build his House with a Ridge or Pinnacle.

PLATFOND is a *French* Word, us'd for the Ceiling or Roof of a Chamber or other Room. The same as *Soffit*.

PLATONICK BODIES, the same that are otherwise call'd *Regular Bodies*.

PLINTH [in *Architecture*] is a flat square Piece or Table in Form of a Brick (from *πλατὺς* in Gr. signifying a Brick) under the Mouldings of the Bases of Columns and Pedestals.

It is us'd as the Foot or Foundation of Columns, seeming to have been originally intended to prevent the Bottom of the Primitive wooden Pillars from rotting.

The *Plinth* of a Statue is a Base or Stand, either flat, round or square, serving to support a Statue.

Plinth of a Wall is a Term us'd by Bricklayers for two or three Rows of Bricks, which advance out from the Wall, or it is us'd in the General for every flat, high Moulding, serving

ing in a Front Wall to mark the Floors, or to sustain the Eaves of a Wall, and the Larmier of a Chimney.

Vitruvius calls the *Tuscan Abacus* Plinth, on Account of the Resemblance it bears to a Brick : It is also call'd *Orlo*.

PLUMB LINE, a Name given by Artificers to a *Perpendicular*, it is thus call'd, because usually describ'd by Means of a Plummet.

PLUMBERY, See *Lead*.

PLUMMET } is an In-
PLUMB RULE } stru-
PLUMB LINE } ment

us'd by Carpenters, Masons, to draw Perpendiculars withal, in Order to judge whether Walls, &c. be upright Planes, horizontal and the like.

It is thus call'd from *Plumbum*, i. e. a Piece of Lead, fastened to the End of a Thread or Chord.

Sometimes the String descends along a wooden Ruler, &c. rais'd perpendicular on another; in which Case it becomes a Level.

POINT [in *Geometry*] is that which is suppos'd to have neither Breadth, Length nor Thickness; but to be indivisible.

1. The Ends or Extremities of Lines are Points.

2. If a Point be suppos'd to be mov'd any Way, it will by its Motion describe a Line.

POINT [in *Perspective*] is a Term us'd for various Parts or Places, with Respect to the Perspective Plane.

Objective POINT, is a Point on a Geometrical Plane, whose

Representation is required on the Perspective Plane.

POINT of *Concourse* } [in
POINT of *Concurrence* } *Opticks*] is that Point where the visual Rays, being reciprocally inclin'd, and sufficiently prolonged, meet together, are united in the middle, and cross the Axis. This Point is most usually call'd the *Focus*, and sometimes the *Point of Convergence*.

POINT of *Dispersion*, is that wherein the Rays begin to diverge, which is usually call'd the *Virtual Focus*.

POINT of *Incidence* is a Point on the Surface of a Glass or other Body, wherein a Ray of Light falls; and as some express it, is that Point of a Glass from which a Ray parts after its Refraction, and when it is returning into the rare Medium again.

POINT of *View*, with Respect to Building, &c. is a Point at a certain Distance from a Building or other Object, wherein the Eye has the most advantageous View or Prospect of the same.

This *Point* is usually at a Distance equal to the Height of the Building, as for Instance, To examine with Judgment the whole of the celebrated Church of the *Invalids* at *Paris*, a Person must not stand at above 340 Foot distant from it, which is pretty near its Height.

To be able to judge of the Ordonnance of its Facade and Frontispiece, and the Regularity of its Order, the Eye should be as far off as the Front-

Frontispiece is high, *viz.* 100 Foot.

But to examine the Correctness of its Profiles, and the Spirit of its Ornaments, the Eye should only be distant the Height of the *Doric* Order, which is about 40 Foot; if it be nearer, the Parts being too much shorten'd, will appear out of Proportion.

A vague or indeterminate Point has a different Effect from the *Point of View*, in that, in looking at a Building from an indeterminate Point; the Eye can only form an Idea of the Magnitude of its Mass, by comparing it with other Buildings adjacent to it.

POINT of Reflection, is a Point on the Surface of a Glass or other Body, whence a Ray is reflected.

POINT of Refraction, is a Point in the Surface of a Glass or other reflecting Surface, wherein the Refraction is effected.

POITRAL, See *Architrave*.

POLYGON [in *Geometry*] A term in the General signifying any Figure of many Sides and Angles, tho' no Figure is call'd by that Name, except it have more than four or five Sides.

If the Sides and Angles be equal, the Figure is call'd a Regular Polygon. Polygons are distinguish'd according to the Number of their Sides; those of five Sides, are call'd *Pentagons*, those of 6, *Hexagons*, those of seven, *Heptagons*, those of eight, *Octagons*, &c.

Euclid demonstrates these which follow.

1. Every Polygon may be divided into as many Triangles as it has Sides.

2. The Angles of any Polygon taken together, will make twice as many Right ones, except 4, as the Figure has Sides,

3. Every Polygon circumscrib'd about a Circle, is equal to a Rectangled Triangle, one of whose Legs shall be the Radius of a Circle, and the other the Perimeter or Sum of all the Sides of the Polygon.

POLYGRAM is a Geometrical Figure, consisting of many Lines.

POLYHEDRON [in *Geometry*] is a Body comprehend'd under several Faces or Sides; such are all the five Regular Bodies.

POLYHEDRON [in *Opticks*] is a Glass or *Lens*, consisting of several plain Surfaces, dispos'd into a Convex Form, popularly call'd a *Multiplying Glass*.

POLYHEDROUS FIGURE [in *Geometry*] is a Solid contain'd under, or consisting of many Sides, which if they are regular Polygons, all similar and equal, and the Body be inscribable within the Surface of a Sphere, 'tis then call'd a Regular Body.

POLYOPTRUM [in *Opticks*] a Glass through which Objects appear multiply'd, but diminish'd. It differs both in Structure and Phenomena.

POLYSCOPES or multiplying Glasses, are such as represent to the Eye one Object as many.

PORCH [in *Architecture*]

a kind of Vestible supported by Columns, much us'd at the Entrance of the ancient Churches.

In the ancient Architecture *Porch* was a Vestible or Disposition of insulated Columns, usually crown'd with a Pediment, forming a Covert Place before the principle Door of either a Temple or Palace.

When they had four Columns in Front, they were call'd *Tetrastyles*, when 6, *Hexastyles*; when 8, *Octostyles*; when 10, *Decastyles*, &c.

PORIME } [in Geometry]

PORIMA } is a Theorem or Proposition, so easy to be demonstrated, that it is almost Self-evident, as that a Chord is all of it within the Circle.

And on the Contrary, they call that an *Aporime*, which is so difficult as to be almost impossible to be demonstrated; as the squaring of any assign'd Portion of *Hippocrates's Lunes* was till lately.

PORISTICK Method [in *Mathematicks*] is that which determines when, by what Way, and how many different Ways a Problem may be resolv'd.

PORPHYRY, a precious kind of Marble, of a brownish red Colour, frequently interspers'd with white Stains, anciently brought from *Egypt*, and exceeding all other in hardness.

The Art, which the Ancients had, of cutting *Porphyry*, seems to be intirely lost. And indeed it is hard to conceive what kind of Tools they must have us'd for fashioning of these large

Columns, and other Works in *Porphyry*, found in the City of *Rome*.

One of the most considerable Pieces that now remains intire, is a Tomb of *Constantia*, Daughter of the Emperor *Constantine*, in the Church of St. *Agnes*, without the Walls; commonly call'd the Tomb of *Bacchus*, because of several Boys represented upon it playing among the Vine Leaves. And that of *Appollo*, and the Busts of 12 Emperors, all of *Porphyry*, in the Palace of the *Tuilleries*.

Some of the ancient Pieces seem to have been wrought with a Chissel, others with the Saw, others, with Wheels, and others ground by Degrees with Emery.

Yet the modern Tools will scarce touch *Porphyry*, so that it may be concluded, either that the Ancients had the Secret of tempering Steel better than we now have, or that as some imagine, they had the Art of softening the *Porphyry*. But it is rather more probable, that Time and the Air have contributed to increase its hardness.

Mr. *Addison* informs us, he saw a Workman in *Rome*, employ'd in the cutting of *Porphyry*; but his Advances were exceeding slow, and almost insensible.

The only Way the *Italian* Sculptors have of working the Pieces of old *Porphyry* Columns that are still remaining (for the *Porphyry* Quarries are long since lost) is with a Brass Saw

Saw without any Teeth. With this together with Emery and Water, they rub and wear it with infinite Patience.

Many Persons have endeavoured to retrieve the ancient Art, particularly *Leon Baptista Alberti*, who searching after the necessary Temper, tells us he found Goat's Blood the best of any; but yet even this avail'd but little; for in working with Chissels tempered herein, Sparks of Fire came more plentifully than Pieces of the Stone.

By this Means Sculptors were able to make a flat or oval Form; but could never attain to the making any Thing like a Figure.

It is indeed reported that *Cosmo de Medici*, in the Year 1555, distill'd a Water from certain Herbs, by the Help of which his Sculptor, *Francisco Tadda* gave his Tools such an admirable Hardness, that he perform'd some fine Works with them; particularly our Saviour's Head in *Demi-Relievo*, *Cosmo's* Head, and his Dutcheſſes. Even the very Hair and Beard, which were very well done, how difficult soever it was; so that there is nothing better in all the Works of the Ancients: but the Secret seems to have died with him.

The *French* have lately found out another Method of cutting *Porphyry*, viz. with an Iron Saw without Teeth, and *Gres*, or a kind of Free-Stone, pulveriz'd and Water.

The Authors of this Inven-

tion, pretend they could perform the whole Contour of a Column hereby, had they Matter to work on.

PORTAL, [in *Architecture*] a little square Corner of a Room, cut off from the rest of the Room, by Wainſcot; frequent in the antient Buildings; but now diffus'd.

It is also us'd for a little Gate, where there are 2 Gates of a different Bigness: It also sometimes signifies a kind of Arch of Joiners Work before a Door.

PORTAIL, [in *Architecture*] signifies the Face or Frontispiece of a Church, view'd on the Side, wherein the great Door is; Also the great Door of a Palace, Castle &c.

PORTICO, [in *Architecture*] is a kind of Gallery built on the Ground; or a Piazza encompass'd with Arches, supported by Columns, where People walk under covert.

The Roof is commonly vaulted. This was by the Antients call'd *Lacunar*.

Altho' the Word *Portico* be deriv'd from *Porta* i. e. a Gate or Door, yet it is apply'd to any Disposition of Columns which form a Gallery; without any immediate relation to Doors or Gates.

The most celebrated Portico's of Antiquity were those of Solomon's Temple, which form'd the *Atrium* and encompass'd the Sanctuary; that of *Athens*, built for the People to divert themselves in; and wherein the Philoſophers held their Disputations and Conversations, which

which was the Occasion of the Greek *Stoicks* of *soa* Gr. a *Portico*: and that of *Pompey* at *Rome*, erected merely for Magnificence; consisting of several Rows of Columns, supporting a Platform of vast Extent, a Design of which *Serlio* presents us with in his *Antique* Buildidgs.

Among the Modern *Portico's* the most celebrated is the *Piazza* of *St. Peter* of the *Vatican*; that of *Covent Garden*, the Work of *Inigo Jones*, is also much admired.

M. Le Clerc says, tho' we have but few Instances of *Arches* or *Porticos* supported by Columns, yet nothing hinders but that they may be us'd where the Architecture is not requir'd to be very strong, as in a plain open Gallery, serving for a Passage or Communication between two Parts of an House, or where 'tis desired to have a slight Terrace in the Front of a Building and a Gallery or Portico underneath.

In a Portico of this Kind, he would have nothing but the Archivolte upon the Column; the Corniche should be plac'd over the Archivolte.

PORTRAIT, } [in
 PORTRAITURE, } *Painting*] the Representation of a Person and especially a Face done from the Life.

PORTLAND Stone, Slabs of *Portland Stone* (ready polish'd for Chimney Foot Paces) 1 s. 8 d. per Foot superficial. It is a Stone much us'd in Building, and much softer and whiter than *Purbeck*.

PORT-NAILS, see *Nails*.

POSTS, [in *Building*] pret-

ty big Pieces of Timber, plac'd upright in Houses &c.

PRINCIPAL POSTS, are the Corner Posts of a House, and the Posts fram'd into Bressummers, between the principal *Prick-Posts* for strengthening the Carcass of a House.

A Method of *Preserving Posts*] It is a very excellent Method of preserving Posts from rotting, to burn the Ends of them that are to be set into the Ground.

POST and RAIL, see *Fencing* and *Paleing*.

POUND NAILS, see *Nails*.

POUDERINGS, [in *Architecture*] a Term sometimes us'd for Devices, in filling up vacant Spaces in carv'd Work.

PRICK-POST. see *Posts*.

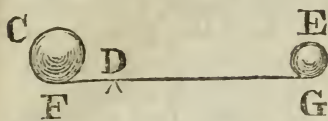
POWERS, [in *Mechanicks*] is whatever can move a heavy Body, and is therefore call'd the moving Force, thus Weight is a Power in Reference to a heavy Body, which it may move.

Power is twofold, that is, either *animate* as the Power of Men, Horse &c, in pulling, drawing &c, or *inanimate*, as the specifick Gravity of a Body of Gold, Iron, Stone, Water &c, as one Pound two Pounds &c of Weight.

The Quantity of Power is estimated by the Quantity of Weight of the Body which it sustains, that is, when a Power sustains twice or thrice its own Weight; then we say that that Power is double or triple that Weight which it doth sustain.

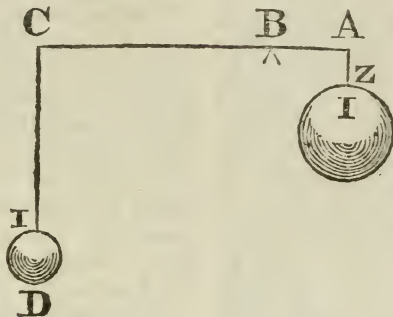
2. The Manner of applying a Power to a *Lever* may be immediately on the *Lever*, as the Weight

Weight E laid on the End of the *Lever* G F.



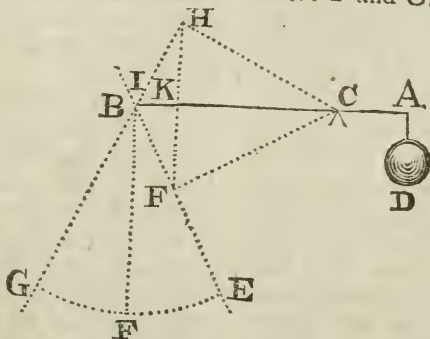
Or at some Distance from it, as the Weight D hung on the

Point C, by Means of the Chord DC and that right Line in which a Power or heavy Body endeavours to move in, is call'd the Line of Direction of that Body: So C I is the line of Direction of the Body D, and A Z of the Weight I.



The real Application of a *Power* to a *Lever* is that Angle, which is constituted by a *Lever* and *Line of Direction* at their Point of meeting: thus the Angle A B E constituted

by the line of Direction E B and the *Lever* A B is the Application of the Power E: So likewise are the Angles A B F and A B G Applications of the Powers F and G.



The Power F, which is apply'd to the *Lever* B at Right Angles, hath the greatest Effect, not only of the other two Powers E and G, but of all others that are not Perpen-

dicular to the *Lever* A B:

The Proof.

1. The Distance of a Weight, or a Power from the *Fulcrum* is the nearest Distance contain'd between the *Fulcrum* and the

the Line of Direction; that is, it is a Right Line or Perpendicular let fall from the *Fulcrum* upon the Line of Direction, as C F on the Line of Direction B E.

2. If you describe the Arch F B, on C, with the Radius C F, it is evident that C K is less than C B, and the Point K is nearer to the *Fulcrum* C than the Point B; and since that the farther the Power is apply'd from the *Fulcrum*, the greater Force it will have: Thence it is evident that the Power F, which acts upon the Part of the Lever B, must have greater Force than the Power E, whose Distance from the *Fulcrum* is = C K, which is less than C B.

But if it shall be suppos'd from hence, that the lesser the Angle of Application is, the greater the Power must be increas'd to become equal to the Power F, and that the greater the Angle of Application is made, as the Angle C B G, the lesser the Force is requir'd to be equal to the Power F.

I answer that the first Supposition upon the Powers apply'd with Angles acute is right; but the Supposition of the Obtuse Angles requiring a lesser Force to equalize F is false, which I shall prove as follows.

1. It has been said already, that the Distance of a Power from the *Fulcrum*, is a Right Line or Perpendicular, let fall from the *Fulcrum* upon the Line of Direction.

2. Since the Lever C B is the Perpendicular it self to the

Line of Direction B F of the Power E, whose Angle C B F is a Right Angle, it is evident that if the Power F be remov'd to G, then the Angle C B G will be an obtuse Angle.

And seeing that when any Right-lin'd Triangle hath one of its Angles obtuse, the Sum of the other two must be less than a Right Angle; because the Sum of all the three Angles taken together, are always equal to two Right Angles, or 180 Degrees.

3. Now the Angle C B G, being an obtuse Angle, it is impossible that a Line can be drawn from the *Fulcrum* C to the Line of Direction B G, and to be perpendicular to it too.

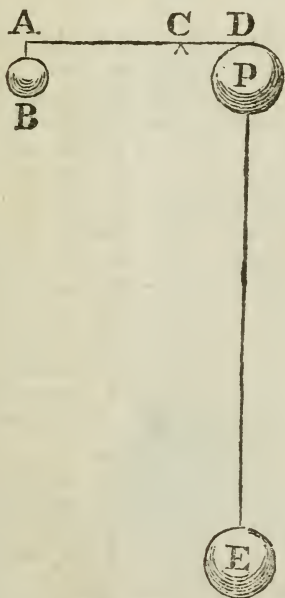
But to supply this Defect, you must continue on the Line of Direction G B, through the Point of Application B, upwards towards H; and then if a Perpendicular be let fall from the *Fulcrum* C, to the continued Line of Direction B H, it will cut the Line B H in H, then C K.

4. If the Distance of the Power G from the Power F be equal the Distance of the Power E from the Power F, then will the Perpendicular C H be equal to the Perpendicular C E, and therefore the Power apply'd at G, whose obtuse Angle C B G exceeds the Right Angle C B F, as much as the acute Angle C B E is less than the Right Angle C B F is equal in Force to the Power E, and both less in Force than the Power E, which was to be demonstrated.

Hence

Hence it is evident, that if the Power *G* was to thrust or press at *H* on *B*, its Force would be the very same, as when pulling at *G*, and that when Workmen apply their Strength to raise up heavy Weights, they should always endeavour to apply the same as near to a Right Angle with a Lever, as they possibly can.

Question. Has not a Power as *P*, being hung close to the Lever *A D*, a greater Force than when hung on the same Point *D* at the End of a long Cord or Line, as the Weight *E*?



Answer. No? If the Bodies *P* and *E* are equal, the Body *E* will have the same Force as the Body *P*, and if the Gravity or Weight of the Cord be con-

sidered and added to it, it will have a greater Force than the Body *P*, for were the Weight *E* to be sustain'd by the End of the Cord at *D*, both their Weights must be sustain'd at the same Time.

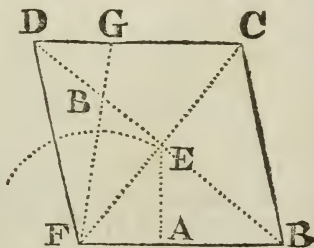
As to the natural Descent of heavy Bodies and of their Line of Direction, in which they endeavour to descend,

A heavy Body naturally descends to the lowest Place it can go, provided that its Descent is not oppos'd by any other heavy body.

And as all the Parts of *Homogeneous* Bodies have an equal Pressure about their Centres of Gravity, therefore the chief Endeavour of Bodies to descend, is made by the Descent of their Centres of Gravity.

For if the Centre of Gravity of a Body do not descend, but remain fix'd, the whole Body will remain fix'd also; because it is to the Centre of Gravity, that all the Parts of the Body have a close Adherence.

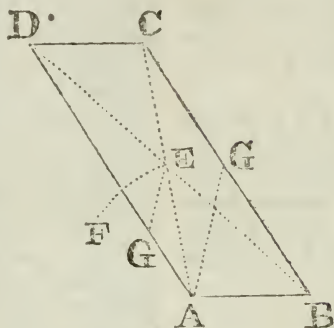
Hence it is plain, that the inclin'd Body *C D B A* cannot fall towards *F*, which it inclines to, because its Centre of Gra-



vity *E*, must be obliged to ascend and pass through the Arch

E P, which it cannot do, the Part or Quantity G C A B standing over the Base, wherein the Centre of Gravity is, being greater than the inclining Part G D A.

Therefore it is evident, that no such Body can descend, when the Line of Direction or Centre of Gravity doth not exceed the Extremes of the Base B A.



And on the Contrary, when the Centre of Gravity of an inclin'd Body, as E exceeds the Limits of the utmost Perpendicular, as G A, whereby the Part standing over the Base G B A is lesser than the inclining Part G A C D: Then such Bodies will fall, for the Centre of Gravity E, having A for its Centre, will freely descend in the Arch E F.

Now 'tis very plain, that to have a Body remain steadfast upon its Base, and not inclin'd, the Line of Direction must of Necessity fall in some Part of the Base of the said Body, or otherwise it will naturally fall.

Whence it follows, that the lesser the Base of any upright Body is, the easier it will move out of its Position; because the least Change is capable of moving the Line of Direction out of its Base.

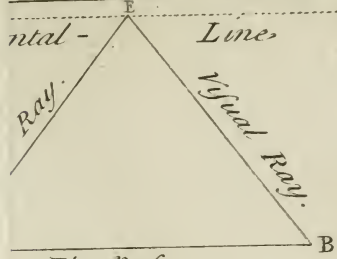
This is the Cause why a Ball or Sphere, whose Base is a Point only, rolls easily on a plain Superficies, by a gentle Force.

The Law of Mechanicks is observ'd by every Animal, in their rising and standing, to prevent their falling; as for Example in human Bodies, when we are to rise from a Seat we naturally bend our Bodies forward, so as to cause the Line of Direction of our Bodies to pass through our Feet, upon which we bear our selves when we begin to ascend.

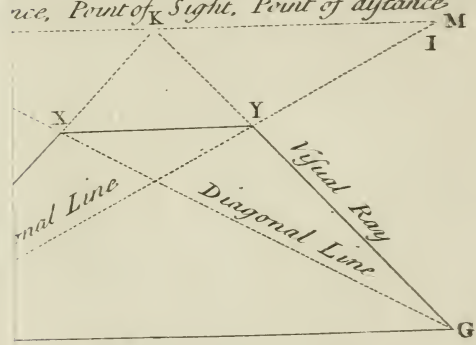
Now from the preceeding it follows, that the wider the Base of any Body is, the easier it will support it self, because then the Line of Direction cannot go out of the Base without greater Force.

This being well understood, will be of very great Service to Painters, Carvers and Statuaries, in giving their Figures such

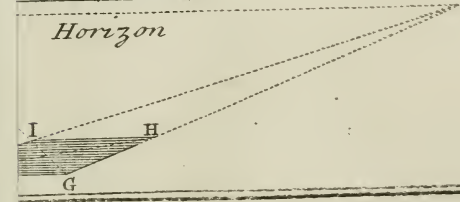
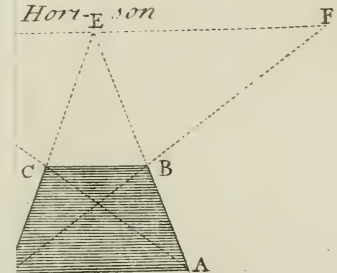
ntal - c Plate XIX.



nce, Point of Sight, Point of distance



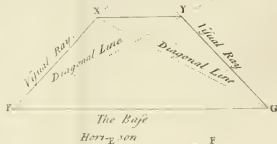
The Base
Horison



D *Horizontal -* Line. C Plate XIX.



Point of distance, Point of Sight, Point of distance.
L H I M



such Postures as are agreeable to Nature; as also to Masons, Bricklayers, &c. in proportioning the Thickness of Walls, according to their several Heights requir'd.

It is worthy Notice, that all the Powers or Bodies produc'd are such as equipoise each other, or are equal in Power to each other, according to their several Ratio's. And therefore,

Take Notice, that when a Power can sustain a Weight, by the Means of any Ballance, Lever, &c. a Power greater, as little as can be imagin'd, will over-poise, or cause the said Weight to rise.

Likewise take Notice, that the Weight of the Levers, Pulleys, &c. and their Friction is not consider'd, a Lever being consider'd as a Right Line, and a Pulley as moving on a real Point.

N.B. *The Copy of the following Articles in POINT and POLYGON, being misplac'd, and not coming Time enough to be put into the last Sheet, we insert it in this.*

POINT of Sight } [in
POINT of the Eye } Per-
Princ^{al} POINT } spec-
Perspective POINT } tive]
is a Point in the Axis of the Eye, or in the Central Ray, where the same is intersected by the Horizon.

Thus the Point E is the Point of Sight in the Horizon C D, wherein all the visual Rays meet. It is call'd the

Point of the Eye, or ocular Point, because directly oppos'd to the Eye of the Person, who is to view the Piece. See Plate Fig. 1.

POINT or POINTS of Distance [in Perspective] is a Point or Points (for there are sometimes two of them) plac'd at equal Distance from the Point of Sight. They are thus denominated by Reason that the Spectator ought to be so far remov'd from the Figure or Painting, and the Terrestrial Line, as these Points are from the Point of the Eye, and are always to be in the Horizontal Line.

Thus H I being the Horizon and K the Point of Sight, L and M are Points of Distance, serving to give all the Shortenings. See the Plate Fig. 2.

Thus ex. gr. If from the Extremes of the Line F G you draw two Lines to the Point K, and from the same Points draw two Lines to the Points of Distance M and L, where these two Lines G L and F M cut the Lines F K and G K in the Point, X and Y will be the Line of Depth, and the Shortening of the Square, whereof F G is the Side and Base. The Lines drawn to the Point of Sight, are all visual Rays, and those drawn to the Points of Distance, are all Diagonals. See Plate Fig. 2.

Accidental POINTS } [in
Contingent POINTS } Per-
spective] are certain Points, wherein such Objects as may be thrown negligently and without Order under the Plan, do

tend to terminate. For this Reason they are not drawn to the Point of Sight, nor the Points of Distance, but meet accidentally or at Random in the Horizon.

POINT of the FRONT [in *Perspective*] is when we have the Object directly before us; and not more on one Side than the other, in which Case it only shews the Foreside, and if it be below the Horizon, a little of the Top too, but nothing of the Sides, unless the Object be Polygonous.

Thus the Plan A B C D, is all Front, and if it were rais'd, we should not see any Thing of the Sides A B or C D, but only the Front A D: The Reason is, that the Point of View E, being directly opposite thereto, causes a Diminution on each Side; which however is only to be understood where an Elevation is the Object; for if it be a Plan, it shews the whole, as A B C D. See the *Plate Fig. 3.*

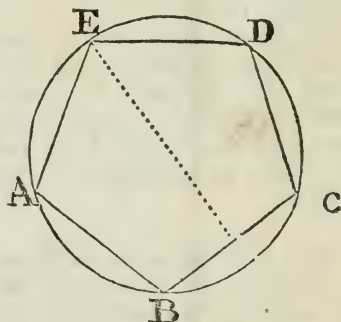
Side POINT. The Point of **OBLIQUE VIEW**, or of the **SIDE**, is when we see the Object aside of us, and only as it were assant or with the Corner of the Eye; the Eye however being all the while opposite to the Point of Sight; in which Case we view the Object laterally, and it presents us two Faces or Sides.

For Instance, if the Point of Sight be in F, the Object G H I K, will appear athwart, and shew two Faces G K, and G H, in which Case it will be a Side Point. The Practice is

the same in the Side Point, as in the Front Points; a Point of Sight, Points of Distance, &c. being laid down in the one as well as the other. See *Plate Figure 4.*

To describe any Regular POLYGON, suppose the PENTAGON A B C D E.

Divide the Circumference of the Circle, viz. 360 Degrees, by (5) the Number of Sides, contain'd in the Polygon, and the Quotient will be the Number of Degrees contain'd in the Arch of one Side.



So 360 being divided by 5, the Quotient will be 72.

Then taking 72 Degrees from your Line of Chords, let that Distance from A to B, from B to C; from C to D; from D to E, and from E to A, and then join A B, B C, C D, D E and E A, the Polygon required.

Regular POLYGONS are all such Figures as have more than four Sides; all the Sides and Angles of them being equal. *Polygons*, are denominated from the Number of their Sides and Angles.

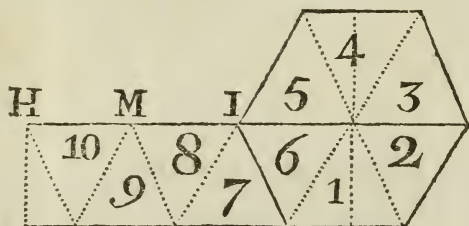
If the Figure consists of	{	5	Equal Sides and Angles, it is call'd a Regular	{	Pentagon.
		6			Hexagon.
		7			Heptagon.
		8			Octagon.
		9			Enneagon.
		10			Decagon.
		11			Endecagon.
		12			Dodecagon.

POLYGON. Every Polygon is equal to a Parallelogram, whose Length is equal to half the Perimeter or Circumference thereof, and Breadth to a Perpendicular drawn from the Centre to the middle of any Side of the same.

Let the Hexagon I D H L O P, be the given Polygon, and E N a Perpendicular, drawn from the Centre N, to the

middle of the Side D H.

2. Draw Right Lines from the Centre N, to the Angles I D H L O P: also continue E D to A, making E A equal to half the Perimeter of the Polygon; that is, make D C equal to H L; C B equal to L O; and H A, equal to E H, then compleat the Parallelogram A E K N, and make I M and M K equal to I N.



Now I say, that the Parallelogram A E K N, whose Length A E is equal to half the Circumference of the Polygon, and Breadth to the Perpendicular E N, is equal to the Polygon D H L O P I. For as the Triangles 1, 2, 3, 4, 5, 6, are all equal to one another; so also are the Triangles, 7, 8, 9 and 10, equal thereto also, because they are all of equal Bases and between the same Parallels A H and K L.

Now seeing that the Trian-

gles D N E, and D I N are already compris'd within the Parallelogram A E K N, it only remains to prove that the Triangles 7, 8, 9, 10, and A B K, are equal to the remaining Triangles of the Polygon E N H, 2, 3, 4 and 5.

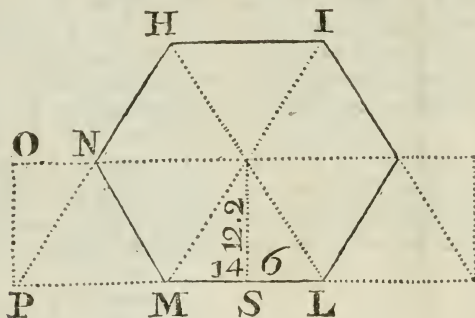
It has been already prov'd, that the several Triangles 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 are equal to one another; therefore the Triangle 7, may be said to be equal to the Triangle 5; the Triangle 8, to the Triangle 4, M 4 the

the Triangle 9, to the Triangle 3, the Triangle 10, to the Triangle 2; and lastly, the Triangle A B K to the Triangle E N H; therefore is the Parallelogram A E K N equal to the Polygon I D H L O P. Q. E. D.

Corollary.

Hence appears the Reason of the general Rule for the Mensuration of Polygons, to multiply half the Circumference by a Perpendicular, let fall from the Centre upon one of the Sides.

To find the Area or Superficial Content of any Regular Polygon.



$$\begin{array}{r}
 14.6 \\
 \underline{3} \\
 43.8 \text{ half Sum of the Sides.} \\
 \underline{12.64 \text{ the Perpendicular.}} \\
 43.8 \text{ half Sum.} \\
 \hline
 10112 \\
 3792 \\
 5956 \\
 \hline
 553.632 \text{ Area.}
 \end{array}$$

$$\begin{array}{r}
 14.6 \\
 \underline{6} \\
 87.6 \\
 \underline{63.2} \\
 1752 \\
 2628 \\
 5256 \\
 \hline
 553.632 \text{ Area.}
 \end{array}$$

Let HIKLM be a Regular Hexagon, each Side thereof being 14.6, the Sum of all the Sides is 87.6 the half Sum is 43.8, which being multiply'd by the Perpendicular 6.32, the Product is 553.632 : or if 87.6, the whole Sum of the Sides be multiply'd by half the Perpendicular 6.32 the Product will be 553.632 the same as before, which is the Area of the given Hexagon.

By Scale and Compaffes.

Extend the Compaffes from 1 to 12.2, that Extent will reach from 43.8, the fame Way to 553.63 : or extend the Compaffes from 2 to 12. That Extent will reach from 87.6, to 553.63.

Demonftration.

Every Regular Polygon, is

equal to the Parallelogram or long Square, whose Length is equal to half the Sum of the Sides and Breadth equal to the Perpendicular of the Polygon, as appears by the preceeding Figure ; for the Hexagon H I K L M N is made up of fix equilateral Triangles, that is five whole ones and two halves ; therefore the Parallelogram is equal to the Hexagon.

A Table for the more readily finding the Area of a Polygon.

Number of Sides.	Names.	Multipliers.
3	Trigon	. 433013
4	Tetragon	1 . 000000
5	Pentagon	1 . 720477
6	Hexagon	2 . 598076
7	Heptagon	3 . 633959
8	Octagon	4 . 828427
9	Enneagon	6 . 181827
10	Decagon	7 . 694209
11	Endecagon	8 . 514250
12	Dodecagon	9 . 330125

Multiply the Square of the Side by the Tabular Number, and the Product will be the Area of the Polygon.

PRIME *Numbers* [in *Arithmetick*] are those made only by Addition or the Collection of Unites, and not by Multiplication, so an Unite only can measure it, as 2, 3, 4, 5, &c. and is by some call'd a *simple*, and by others, an *uncompound Number*.

PRIME *Figure* [in *Geometry*] is that which cannot be divided into any other Figures more Simple than it self ; as a Triangle into Planes, a Pyramid in Solids ; for all Planes are

made of the first, and all Bodies or Solids are compounded of the Second.

PRIMING [in *Painting*] is the laying on of the first Colour.

PRINCIPAL *Point*, [in *Perspective*] is a Point in the Perspective Plane, upon which a Line drawn from the Eye, perpendicular to the vertical Plane ; or it is that Point of a Picture, wherein a Ray, drawn perpendicular to it, cuts it.

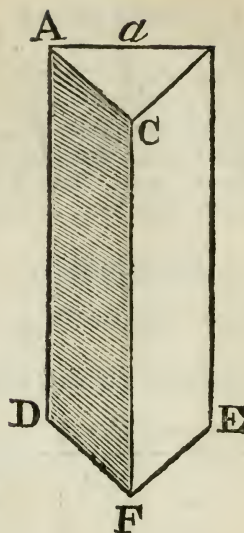
PRINCIPAL *Ray* [in *Perspective*] is that which passes perpendicularly from the Spectator's Eye, to the Perspective or vertical Plane.

PRISM-

PRISM is a Solid contain'd under several Planes, and having its Bases alike equal and parallel, the Solid Content of a Prism (whether Triangular or Multangular) is found by multiplying the Area of the Base into the Length or Height, and the Product will be the solid Content.

Let A B C D E F be a triangular Prism, each Side of the Base being 15. 6 Inches; the Perpendicular of it C a, is 13. 51 Inches, and the Length of the Solid, 19. 5.

Multiply the Perpendicular of the Triangle, 13. 51. by half the Sum 7. 8; and the Product will be 105. 378, the Area of the Base; which multiply by the Length 19. 5, and the Product will be 2054. 871,



which divide by 144, and the Quotient is 14. 27 Feet fere, the Solid Content.

$$\begin{array}{r}
 13.51 \\
 \times 7.8 \\
 \hline
 10808 \\
 9457 \\
 \hline
 105378 \\
 \times 19.5 \\
 \hline
 526890 \\
 948402 \\
 \hline
 105378 \\
 \hline
 2054.8710
 \end{array}$$

$$\begin{array}{r}
 144 \overline{) 2054.87} \quad (14.27 \\
 \underline{144} \\
 614 \\
 \underline{576} \\
 388 \\
 \underline{288} \\
 1007 \\
 \underline{1008} \\
 \hline
 \hline
 \end{array}$$

By Scale and Compasses.

First, Find a mean Proportional between the Perpendicular and half Side, by dividing the Space upon the Line (as taught in the Parallelopipedon) between 13.51 and 7.8, into 2 equal Parts; so shall you find the middle Point between them to be at 10.26, which is the mean Proportional sought; by

this Means the Triangular Solid, is brought to a square, each Side being 10.26 Inches.

Then extend the Compasses from 12 to 10.26; that Extent turn'd twice downwards from 19.5 Feet the Length, will at last fall upon 14.27. which is 14 Feet and a little above a quarter.

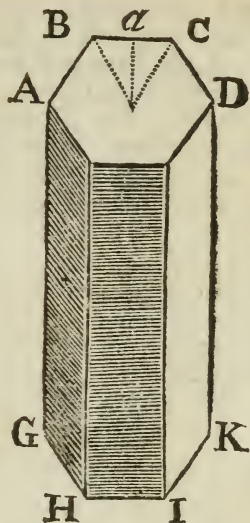
Hexan-

P R

P R

Hexangular PRISM. Let A B C D E F G H I K, represent a Prism, whose Base is a Hexagon, each Side of which is 16 Inches, and the Perpendicular from the Centre of the Base to the middle of one of the Sides (*ab*) is 13.84 Inches, and the Length of the Prism is 15 Feet; the Solid Content is requir'd.

Multiply half the Sum of the Sides 48 by 13.84, and the Product will be 664.32, the Area of the Hexagonal Base, which multiply by 15 Feet, the Length of the Product will be 9964.8, which divide by 144, and the Quotient will be 69.2 Feet, the Solid Content requir'd.



$$\begin{array}{r}
 13.84 \\
 48 \\
 \hline
 11072 \\
 5536 \\
 \hline
 664.32 \\
 15 \\
 \hline
 332160 \\
 66432 \\
 \hline
 9964.80
 \end{array}$$

$$\begin{array}{r}
 144) 996480 (69.2 \\
 \underline{864} \\
 1324 \\
 \underline{1296} \\
 288 \\
 288 \\
 \hline
 000
 \end{array}$$

664.32 Area of the Base. 288
15 288

By Scale and Compasses.

First, Find a mean Proportional between the Perpendicular and half the Sum of the Sides, that is, divide the Space between 13.84 and 48, and the middle Point will be 25.77.

Then extend the Compasses

from 12 to 25.77; and that Extent will reach (being twice turn'd over) from 15 Feet the Length, to 69.2 Feet the Content.

To find the Superficial Content of any of these Solids, you must take the Girt of the Piece, and multiply by the Length

Length, and to that Product add the two Areas of the Bases, and the Sum will be the whole Superficial Content.

Example. The Hexagonal Prism, the Sum of the Sides

$$\begin{array}{r}
 180 \\
 96 \\
 \hline
 1080 \\
 1620 \\
 \hline
 17280 \\
 664 \ 32 \\
 664 \ 32 \\
 \hline
 18608 \ 64
 \end{array}$$

The Superficial Content of the whole Solid is 129.22.

By Scale and Compasses.

Extend the Compasses from 144 to 180, and that Extent will reach from 96 to 120 Feet; then to find the Area of the Base, extend the Compasses from 144 to 13.84 and that Extent will reach from 48 to 4.6 Feet; add 120 Feet, and twice 4.6 Feet, and it will make 129.22 Feet, the Superficial Content, as before.

The Demonstration of these Prisms will be the same as in that of the Cube; for as in that, so in those, the Area of the Base is multiply'd into the Length to find the Content, and the same Reason is given for the one, as for the other.

1. PRISM [in *Opticks*] is a Glass bounded with two equal and parallel triangular Ends, and three plane and well polish'd Sides, which meet in three parallel Lines, running

being 96, the Product will be 17280 square Inches, to which add twice 664.32 the Area's of the two Bases; and the Sum is 18608.64, the Area of the whole which is 129.22 Feet.

$$\begin{array}{r}
 144) 18608.64 (129.22 \\
 \hline
 420 \\
 1328 \\
 \hline
 326 \\
 384 \\
 \hline
 96
 \end{array}$$

from the three Angles of one End to those of the other; and is us'd in *Opticks* to make many noble and curious Experiments about Light and Colours; for the Rays of the Sun falling upon it at a certain Angle, do transmit thro' it a Spectrum or Appearance, colour'd like the Iris or Rainbow in the Heavens.

2. The Surface of a Right Prism, is equal to a Parallelogram of the same Height, having for its Base a Right Line equal to the Periphery of the Prism.

3. All Prisms are to one another in a Ratio, compounded of their Bases and Heights.

4. All like Prisms are to one another in the Triplicate Ratio of their answerable Sides.

5. A Prism is the Triple of a Pyramid of the same Base and Height.

PRISMOID [in *Geometry*] is a solid Figure, bounded by several Planes, whose Bases are Right angled Parallelograms, parallel and alike situated.

PROBLEM [in *Geometry*] is a Proposition wherein some Operation or Construction is required, or it is a Proposition which refers to Practice, or which proposes something to be done; as to divide a Line, to construct an Angle, to draw a Circle into three Points, not in a Right Line, &c.

Wolffius says a *Problem* consists of three Parts.

1. The Proposition which expresses what is to be done.

2. The Resolution or Solution, wherein the several Steps whereby the Thing required is to be effected, are orderly rehearsed.

3. The Demonstration wherein is shewn, that by doing the several Things prescrib'd in the Resolution, the Thing requir'd is obtain'd.

Accordingly the general Tenor of all *Problems* is this, the Things prescrib'd in the Resolution being done, the Thing required is done.

To **PRODUCE** [in *Geometry*] signifies to continue a Right Line, or draw it out farther, till it have any assigned Length.

PRODUCT [in *Arithmetic*] is the Number arising from, or produc'd by the Multiplication of two or more Numbers into one another. Thus if 5 be multiply'd by 4, the Product is 20.

PRODUCT [in *Geometry*]

is the Quantity arising by the Multiplication of two or more Lines one into another; in Lines it is always call'd the *Rectangle*.

PROFILE [in *Architecture*] is the Figure or Draught of a Building or the like, wherein are express'd the several Heights, Breadths and Thicknesses, such as they would appear if the Building were cut down perpendicularly from the Roof to the Foundation, whence the *Profile* is also call'd the *Section*, and by *Vitruvius*, *Sciagraphy*.

PROFILE is also us'd for the Contour or Out-line of any Member of a Building, as that of the Base, a Cornice or the like.

Hence *Profileing* is sometimes us'd for designing or describing the Member with Rule, Compass, &c.

PROFILE is us'd for a Prospect of any Place, City or Piece of Architecture, view'd Sideways, and express'd according to the Rules of Perspective.

PROFILE is sometimes us'd for a Design or Description; in Opposition to a Plan or *Ichnography*. In which Sense *Profile* signifies the same with what we popularly call a Prospect, as above.

PROFILE [in *Sculpture*, *Painting*, &c.] is us'd of a Head, Portrait, &c. which are said to be in Profile, when they are represented Sideways, or with a Side view: As when in a Portrait, there is but one Side of the Face, one Eye;

one

Cheek, &c. shown, and nothing of the other.

PROJECTILES [in *Mechanicks*] are heavy Bodies put into a violent Motion, by any great external Force impress'd thereon; and then cast off or let go from the Place where they received their Quantity of Motion, and are afterwards moved at a Distance from it, as a Stone thrown out of a String, an Arrow from a Bow, a Bullet from a Gun, &c.

PROJECTION [in *Mechanicks*] is the Action of giving a Projectile its Motion.

Monstrous PROJECTION, See ANAMORPHOSIS.

PROJECTURE [in *Architecture*] signifies the Out-jetting, Prominency or Embosment, which the Mouldings, and other Members have, beyond the naked Wall, Column, &c. and is always in Proportion to its Height.

The Word is also apply'd to Galleries, Balconies, &c. which jet out beyond the Face of the Wall.

Vitruvius gives it as a general Rule, that all *Projecting* Members in Building, have their *Projectures* equal to their Heights. But this is not to be understood of particular Members or Mouldings, as Dentils, Corona's, the *Fasciæ* of Architraves, the *Abacus* of the *Tuscan* and *Dorick* Capital, &c. but only of the *Projectures* of intire Cornices.

Some modern Architects are of Opinion that the great Point in Building consists in knowing how to vary the Proportions of

Projectures agreeable to the Circumstances of the Building.

Thus they say the nearness and remoteness making a difference in the View requires different *Projectures*, but it's plain that the Antients had no such Intention.

M. *Perrault* observes that the *Projecture* of the Base and Cornice is greater in the Antique than in the modern Buildings by $\frac{1}{3}$: which seems to follow in good Measure from the Antients Proportioning the *Projecture* to the Height of the Pedestal; whereas the Moderns make the *Projecture* the same in all the Orders, tho' the Height of the Pedestal be very different.

PROPORTION [in *Arithmetick*] is the identity or similitude of two ratio's.

Arithmetical Proportion, is the equality of two or more arithmetical ratio's, or the equality of difference between three several quantities.

Geometrical PROPORTION is the equality of two geometrical ratio's or comparisons of two couples of Quantities.

PROSTYLE [in *Architecture*] a range of columns in the front of a Temple.

PROTHYRUM [in *Architecture*] a Porch at the outward door of a House.

PROTHYRIS is also used by *Vignola* for a particular sort of a Key of an Arch, an instance of which is found in his *Ionick* Order; which consists of a roll of water leaves, between two Riglets and two Fillets, crown'd with a *Dorick Cymatium*; its figure being much like that of a *Modillion*.

PRO.

PROTHYRIS [in the ancient *Architecture*] is also sometimes used for a Quoin or corner of a Wall; and also sometimes for a cross Beam and overthwart Rafter.

PSEUDO-DIPTERE [in the ancient *Architecture*] a Temple, having eight columns in front, and a single row of columns all around.

PUDLAYS, pieces of stuff to do the office of levers or handspikes.

PULVINATA a Freeze, a swelling or bulging out in manner of a Pillow.

PULLEY [in *Mechanicks*] is one of the five mechanical powers, consisting of a little wheel or rundle, having a channel round it, and turning on an Axis, serving (by means of a rope which slides in the channel) for the raising of Weights.

In several cases where the *Axis* in *Peritrochio* cannot conveniently be apply'd, Pulleys must be made use of in raising weights.

A Machine form'd by combining several of them, lies in a little compass, and is easily carried about, if the Weight be fixt to the Pulley, so that it may be drawn up along with it: Each end of the drawing or running rope sustains half the weight; therefore when one End is fixt either to a Hook or any other Weight the moving force, or power apply'd to the other end of it, if it be equal to half the weight, will keep the weight in equilibrio.

Several sheaves may be join'd in any manner, and the weight

be fixt to them; then if one end of the Rope be fixt, and the Rope goes round all those sheaves, and as many other fixed ones as is necessary, a great weight may be rais'd by a small power.

In that case the greater number of sheaves fix'd in a moveable pulley, or of moveable wheels (for the fixed ones do not change the action of the power) so much may the power be less which sustains the weight; and a power which is to the weight, as the number one, to twice the number of the Sheaves.

The Doctrine of the Pulley.

If a power P , sustains a weight Q , by means of a single pulley AB , in such manner as that the Line of Direction of each is a tangent to the periphery of the rundle, the weight and the power are equal. See *Plate Fig. 1.*

Hence, a single *Pulley*, if the lines of direction of the power and weight be tangents to the periphery, neither assists nor impedes the power.

The use of the *Pulley* therefore is, when the vertical direction of a power is to be changed into an horizontal one; or an ascending one into a descending one, and on the contrary.

This is found a good provision for the safety of the workmen employ'd in drawing with the *pulley*: For suppose a large weight EFG , be required to be rais'd to a great height, by workmen pulling the rope AB :
if

if now the rope should chance to break, the workmens heads underneath would be in immediate danger ; but if by means of the pulley B, the vertical direction AB, be changed into a horizontal one BC, there is no danger from the breaking of a Rope. This change of direction by means of a pulley, has this advantage further, that if any power can exert more force in one direction than another, we may be here able to employ it in the greatest force. See *Plate Fig. 2.*

Thus for Example, a horse cannot draw in a vertical direction ; but draws with all its advantage in a horizontal one ; therefore by changing the vertical draught into a horizontal one, a horse becomes qualified to raise a weight.

2. If a power apply'd in G, according to the line of direction BE, which is a tangent to the pulley in E, and parallel to the rope AD, sustain the weight F, suspended from the center of the pulley G, the power is subduple of the weight. See *Plate Fig. 3.*

But the grand use of the pulley, is where several of them are combin'd ; thus forming what *Vitruvius* and others after him call *Polyspasta* ; the advantages whereof are, that the machine takes up but little room, is easily removed, and raises a very great weight with a very moderate force.

The Effect of *Polyspasta* is founded upon the following Theorem.

3. If a power apply'd in B,

sustain (by means of a *polyspaston*) a weight F, so that all the ropes AB, HI, GE, EL, CD drawn by the weight F, are parallel to each other : The power will be to the weight, as unity to the number of ropes HI, GF, FL, CD, drawn by the weight B, and therefore as unity is to the number of pulleys higher and lower taken together. See *Plate 2. Fig. 4.*

Hence the number of pulleys and the power being given, it is easy to find the weight that will be sustained thereby : or the number of pulleys and weight to be sustained being given, the power is found ; or the weight and power being given, the number of pulleys the *polyspaston* is to consist of is found.

4. If a power move a weight by means of several pulleys, the space passed over by the power, will be to the space passed over by the weight, as the weight is to the power.

Hence, the smaller the force that sustains the weight, (by means of the pulley) is, the slower is the weight raised, so that what is sav'd in force, is spent in time. Others define

A PULLEY to be a wheel of wood, brass, iron, &c. that is moveable about a small pin or axis, call'd a center-pin, to which in theory we allow no thickness, and therefore is considered as a line only.

This pin with the wheel is fix'd in a box of iron or wood, &c. wherein it is work'd by means of a rope plac'd in the groove of its circumference, as in the figure 5. There

There are several kinds of Pulleys; as the single pulley, (call'd by workmen a *Snatch-Block*) and the double triple, &c. pulley, call'd a pair of blocks, &c.

In order to conceive how heavy weights may be rais'd by the power of the pulley, observe first to equipoise the weight by the single pulley BAC.

If the Diameter of the pulley BC, be considered as a *lever* of the first kind, wherein A is the *Fulcrum*, it is evident that B and C, the extreame ends of the diameter BC, are at equal distances from the *fulcrum* A, wherefore to equipoise the body there must be a weight at E equal to D.

For, as AC the distance of the power,

Is to BA, the distance of the weight;

So is the weight D, to the power E, or *e contra*.

So is the power E, to the weight D.

Hence 'tis plain, that an upper pulley as BAC is a lever of the first kind (see LEVER) and its *fulcrum* is at equal distances from the points of distance of the power apply'd and weight to be rais'd, therefore the power apply'd cannot equipoise any greater weight than one which is equal to itself.

See *Plate Fig. 4.*

So that it may seem, that a pulley is of no more use, than that by its turning motion it preserves the rope from fretting, and from a very great friction, which would require an additional strength, when

drawn over an immoveable body, as a beam, &c. that would not turn as a pulley does.

But in answer to this, it is indeed so in upper Pulleys, but in them only: for 'tis otherwise in under Pulleys, as the Pulley NKL. *Fig. 5.*

The difference lies in this; as you may observe, the weight M hangs in the middle at R, and the Rope FN is always lifting at N, and as the other Rope LR, is fix'd at R, therefore considering the Diameter of the Pulley NLK as a *Lever* of the second kind, the point N, will be the Point where the Power is apply'd, and the Point L will be the *Fulcrum*. Then I say,

As KL, the distance of the weight from the *Fulcrum*.

Is to NL, the distance of the power from the *Fulcrum*;

So is the power apply'd at N, to the weight that it will equipoise at K.

Hence it is plain, that as the distance of the power, is equal to twice the distance of the weight, therefore the power apply'd will equipoise double its weight; wherefore it is always to be understood, that by every such Pulley the Force is doubled. See *Plate Fig. 5.*

Now from these two Examples, arises the following THEOREM.

When a Power (as X) sustains, or draws a weight, by means of several Pullies, (as BC, IOK, LM; EOF,) each Pulley under which the Rope goes, as EOF, or LM, is equivalent to a *Lever* of the second kind,

kind, as before prov'd, and therefore needs no Demonstration.

It is evident, that every lower *Pulley* is a Lever of the second kind; and as the weight is always in the middle between the power and *Fulcrum*, 'tis very easy to judge or determine, what number of under-Pulleys are necessary to equipoise any weight with a given Power.

As for *Example*.

Suppose a Body of 500 Pounds weight, is to be equipois'd by a Power of 25 Pounds weight; how many under Pulleys are required for that Purpose?

This Question is easily answered; for as the Power is equal to double the weight, therefore 25 Pound apply'd to one Pulley, will equipoise 50 Pound.

Now if 500, the weight given, be divided by 50, the equipoise of one under Pulley, the Quotient will be 10, the number of under Pulleys required.

But this is worthy Notice; That as much as the Power gains, in Force by means of many under Pulleys, so much it loses in Space and Time. See *Plate*, Fig. 6.

Suppose a Power apply'd at A, which draws the Rope downwards to R, to draw up or raise the four Weights B C D E, of the Box P Q, on which they are fix'd.

I say, that in this and all such Cases, the Power A must descend, or run through a great Space, while the Weights rise through a small Space; that is,

the Power A must move eight Feet to raise the Bodies B C D E one foot, because eight Parts of the Rope are apply'd to the lower Pulleys; therefore it is to be observed in the use of Pulleys as in the use of Levers.

That the Space which the weight runs through,

Is to the Space which the Power runs through;

As the Power,

Is to the Weight.

Or, As the Number one,

Is to twice the Number of lower Pulleys, *viz.* 8;

So is the Power apply'd, to the weight that it will equipoise.

Thus it appears, that the more Velocity the Power has, the greater is its Force proportionably.

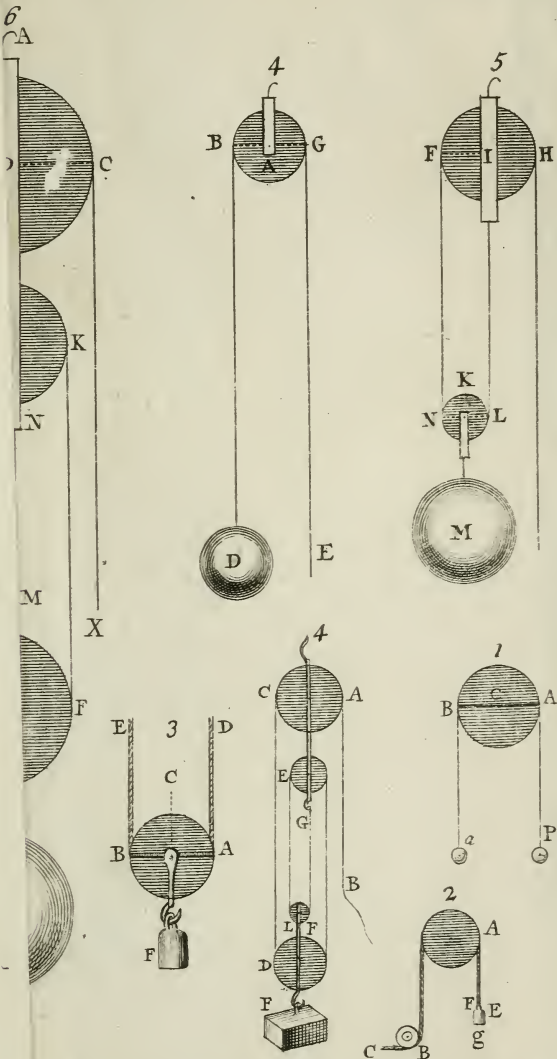
PUMP [in *Hydraulicks*] is a Machine formed of a Syringe for raising of Water.

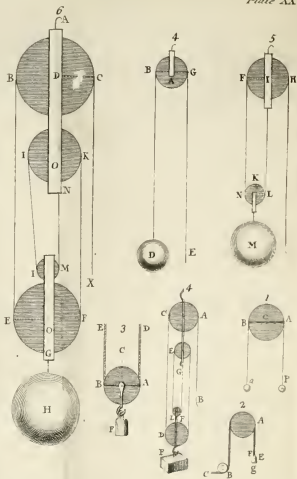
PUMPS are distinguished into several Kinds, with respect to the several manners of their acting. As,

1. The *Common Pump*, sometimes called the *Sucking Pump*, which acts by the Pressure of the Air, and whereby Water is rais'd out of lower into a higher Place not exceeding 32 Foot.

The *Forcing Pump*, which acts by mere Impulse and Protrusion, and raises Water to any Height at Pleasure; and also another.

Called *Ctesibius's Pump*, which was the first and is the finest of them all, which acts both by Suction and Expulsion.





PUNCHEON is a common Name for all the Iron Instruments used by Stone-Cutters, Sculptors, Locksmiths, &c. for cutting or piercing their several Matters.

PUNCHION } [in *Carpentry*]
PUNCHIN } A piece of Timber placed upright between two Posts, whose bearing is too great, serving together with them to sustain some great Weight.

The **PUNCHEON** is usually lower and slighter than the Posts, and is join'd by a Brace or the like of Iron.

Puncheon is also a piece of Timber raised upright, under the Ridge of a Building, wherein the little Forces, &c. are jointed. *Vitruvius* calls the *Puncheon Columen*. *Puncheon* is also used for the Arbour or principal Part of a Machine, on which it turns vertically as that of a Crane, &c.

PURLINS [in *Building*] those pieces of Timber that lie a-cross the Rafters on the inside, to keep them from sinking in the middle of their Length.

By the Act of Parliament for the rebuilding of *London*, it is provided, that all Purlins from 15 Foot 6 Inches to 18 Feet 6 Inches long, ought to be in their Square 9 Inches and 8 Inches: And all in length from 18 Foot 6 Inches to 21 Foot 6 Inches, ought to be in their Square 12 Inches and 9 Inches.

PURBECK-STONE is a hard, greyish Stone, almost like *Suffex-Petties*, they are used for Pavements.

As to the Price, it is com-

monly sold in Slabs (ready polish'd for Chimney-foot Paces) for 2 s. per Foot. And Purbeck paving of promiscuous Sizes, only hew'd and squar'd is sold for about 7 d. per Foot; also Mitchels are valued at about 1 s. 10 d. per Foot.

PUTLOGS [in *Carpentry*] are short pieces of Timber (about 7 Foot long) used by Masons in building Scaffolds to work upon. The Putlogs are those pieces that lie at right Angles to the Wall, or horizontal to the Building, with one of their Ends resting on the Ledgers of the Poles, which are those pieces that lie parallel to the side of the Wall of the Building.

PYCNOSTYLE } [In an-
PYCHNOSTYLE } cient
Architecture] is a Building where the Columns stand very close one to another; one Diameter and a half of the Column being allow'd for the Intercolumniations.

The *Pycnostyle*, is the smallest of all the Intercolumniations mentioned by *Vitruvius*.

Some make the *Pycnostyle* the same with the *Systyle*; others distinguish the latter by its allowing half a Module more in the *Corinthian* intercolumniations.

Mr. *Evelyn* observes, that the *Pycnostyle* chiefly belonged to the *Composite* Order; and was used in the most magnificent Buildings, as at present in the *Peristyle* of St. *Peter's* at *Rome*, consisting of near 500 Columns; and such as yet remain of the Ancients, among the

the late discovered Ruins of *Palмира*.

PYLING the Ground for Foundation.

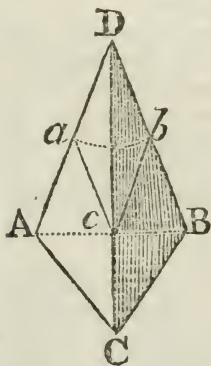
PYRAMID [in *Geometry*] is a Solid standing on a square Base, and terminating at Top in a point : Or it is a Body whose Base is a *Polygon*, and whose Sides are plane Triangles ; the several Tops meeting together in one point.

The Properties of a Pyramid are,

1. All *Pyramids* and Cones standing on the same Base, and having the same Altitude, are demonstrated to be equal.

2. A Triangular *Pyramid* is the third part of a Prism standing on the same Base, and of the same Altitude.

3. Hence, since every Multangular may be divided into Triangulars. Every Pyramid is the third Part of a Prism standing on the same Base, and of the same Altitude.



4. If a *Pyramid* be cut by a Plane *abc*, parallel to its Base *ABC*, the former Plane or Base will be similar to the latter.

5. All *Pyramids*, *Prisms*, *Cy-*

linders, &c. are in a Ratio compounded of their Bases and Altitudes, the Bases therefore being equal, they are in Proportion to their Altitudes ; and the Altitudes being equal in Proportion to their Bases.

6. *Pyramids*, *Prisms*, *Cylinders*, *Cones*, and other similar Bodies are in a triplicate Ratio of their homologous Sides.

7. Equal *Pyramids*, &c. reciprocate their Bases and Altitudes, *i. e.* the Altitude of the one, is to that of the other ; as the Base of the one, to that of the other.

A *Sphere* is equal to a *Pyramid*, whose Base is equal to the Surface, and its Height to the Radius of the Sphere.

8. A *Pyramid* is one third of the perpendicular Altitude multiply'd by the Base.

To measure the Surface and Solidity of a Pyramid.

Find the Solidity of a Prism that has the same Base with the given Pyramid, and divide this by 3 ; the Quotient will be the Solidity of the Pyramid.

Suppose *v. gr.* the Solidity of the Prism be found 67010328 the Solidity of the Pyramid will be thus found 226336770.

The Surface of a Pyramid is had by finding the Areas both of the Base *ABC* and of the lateral Triangles *ACD*, *CBD* and *BDA*, the Sum of these is the Area of the Pyramid.

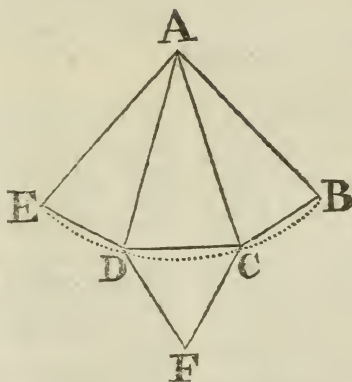
The external Surface of a right Pyramid standing on a regular Polygon Base, is equal to the Altitude of one of the Triangles

angles which compose it, multiplied by the whole Circumference of the Base of the Pyramid.

To describe a Pyramid, on a Plane.

First draw the Base *v. gr.* the Triangle ABC (if the Py-

ramid required, be Triangular) so as that the Side AB suppos'd to be turned behind, be not express'd. 2. On AC and CB, construct the Triangles ADC, and CDB, meeting in any assumed or determined Point, *v. gr.* D, and draw AD, CD, BD, then will ADBC be a Triangular Pyramid.



To Construct a Pyramid of Paste-Board, &c.

Suppose, *v. gr.* a Triangular Pyramid required.

1. With the Radius AB, describe an Arch BE, as in the Figure, and thereto apply three equal Chords BC, CD and DF.

2. On DC construct an equilateral Triangle DFC, and draw the Right-lines AD and AC, this Paste-board, &c. being cut off by the Contour of the Figure, what remains within will turn up into a Pyramid.

To find the Solid Content of a Pyramid.

The RULE.

Multiply the Area of the Base by a third part of the Altitude, and the Product will be the Solid Content of the Pyramid.

Let ABD be a square Pyramid, each Side of the Base being 18.5 Inches, and the perpendicular Height CD is 15 Feet: Multiply 18.5 by 18.5, and the Product is 340.25 the Area of the Base in Inches, which multiply'd by 5, a third Part of an Inch, and the Product of that will be 1711.25, this being divided by 144, the Quotient will be 11.88 Feet.

P Y

18.5

18.5

925

1480

185

342.25 Area of Base.

5

144)1711.25(11.88 Content.

By Scale and Compasses,

Extend the Compasses from 12 to 18.5 Inches, that Extent turn'd twice over from 5 Feet (a third Part of the Height) will fall at least upon 11.88 Feet, the solid Content. *Pl. 2. Fig. 1.*

To find the Superficial Content.

Multiply the slanting Height

180.24

37

126168

54072

144)6668.88(46.31

576

2.38

908

48.69

864

448

432

168

144

24

P Y

F.

I.

P.

1 : 6 : 6

1 : 6 : 6

1 : 6 : 6

9 : 3

9.3

2 : 4 : 6.3

5

11 : 10 : 7.3

(or Perpendicular of one of the Triangles) by half the Periphery of the Base 37, and the Product will be 6668.88, which being divided by 144, the Quotient will be 46.31 Feet: the Superficial Content of all but the Base; then to that add 2.38 Feet the Base, and it makes 48.69 Feet, the whole Superficial Content.

144)342.25(2.38

288

542

432

1105

1152

By

By Scale and Compasses.

Extend the Compasses from 144 to 180.24, and that Extent will reach from 37 to 46.31 feet, the Area of the four Triangles; and extend the Compasses from 144 to 18.5 (one Side of the Base) that Extent will reach from 18.5 to 2.38 fere; which added to the other, the Sum is 48.69, the whole Superficies.

Demonstration.

Every Pyramid is a third Part of a Prism, which hath the same Base and Height (by *Euclid* 12.7.)

That is, the Solid Content of the Pyramid ABD, is one third Part of its circumscribing Prism ABEF.

For every Pyramid which has a square Base (such as *AaBb* in the Figure) is constituted of an infinite Series of Squares, whose Sides or Roots are continually increasing in Arithmetical Progression, beginning at the Vertex or Point D, its base *AaBb* being the greatest Term, and its Perpendicular Height CD is the Number of all the Terms; but the last Term multiplied into the Number of Terms, the Product will be triple the Sum of all the Series; consequently $\frac{NLL}{3} = S$.

And *S* is equal to the Solid Content of the Pyramid.

From hence it will be easy to conceive, that every Pyramid is a third of its circumscribing Prism (that is of a Prism of equal base and Altitude) of what form soever its base is of, viz. whether it be Square, Triangular, Pentangular, &c.

You may very easily prove a Triangular Pyramid to be a third part of a Prism of equal Base and Altitude, by cutting a Triangular Prism of Cork, and then cut that Prism into three Pyramids; by cutting it diagonally.

A *Triangular* PYRAMID. Let ABC, be a Triangular Pyramid, each Side of the Base being 21.5 Inches, and its perpendicular Height 16 Feet, the Content both Solid and Superficial is desired. *Plate 2. Fig. 2.*

First, find the Area of the Base, by multiplying half the Side by the Perpendicular, let fall from the Angle of the Base to the opposite Side; which Perpendicular will be found to be 18.62, the half of which is 9.31, which multiplied by 21.5, the Product will be 200.165 Inches the Area of the Base; then because the Altitude 16 cannot be exactly divided by 3, therefore take a third Part of 200.165, which is 66.72, and multiply it by 16, and the Product will be 1067.52, which divided by 144, the Quotient will be 7.41 Feet, the Solid Content.

P Y

P Y

9.31 Half Perp.	F.	I.	P.
21.5 The Side	Side 1	: 9	: 6
	Half Perpend.	9	: 4
<hr/> 4655			
931	1	: 4	: 1 : 6
1862			7 : 2
<hr/>			
3)200.165 Area Base	Area Base 1	: 4	: 8 : 8
			4
66.72 a third Part			
16 Height	5	: 6	: 10 : 8
			4
<hr/> 40032			
6672	3)22	: 3	: 6 : 8
<hr/>			
144)106752(7.41 Solid Content.	7	: 5	: 2 : 2
1008			
<hr/>			
595			
576			
<hr/>			
192			
144			
<hr/>			
48			

N.B. In casting up this by Feet and Inches, instead of multiplying by 16 the Height, I divide 12 into such 4 Numbers as being multiplied together, the Product may be 16, as 4 and 4, and multiply first by one and then by the other, and a third part of the last Product is the Content.

By Scale and Compasses.

First, find a Geometrical mean Proportional (as before directed) by dividing the Space between 21.5 and 9.31, into two equal Parts, and you will find

the middle Part at 14.15, which is the mean Proportional sought.

Then extend the Compasses from 12 to 14.15, and that Extent (turn'd twice over from 16) will fall at last upon 22.23, a third of which is 7.41 Feet, the Content.

To find the Superficial Content.

Multiply the slant Height, (or Perpendicular of one of the Triangles) by half the Periphery of the Base, and to that Product add the Area of the Base, and the Sum will be the whole Superficial Content.

192.1 Inches the flant Height at D.
 Half Periph. $32.25 = 21.5 + 10.75$

$$\begin{array}{r} 9605 \\ 3842 \\ 3842 \\ \hline 5763 \end{array}$$

6195.225 Inches the Area of all but the Base.
 200.165 Area of the Base, add

144) 6395.390 (44.41 Feet the whole Content.
 576

$$\begin{array}{r} 635 \\ 576 \\ \hline \end{array}$$

$$\begin{array}{r} 593 \\ 576 \\ \hline \end{array}$$

$$\begin{array}{r} 179 \\ 144 \\ \hline \end{array}$$

$$35$$

By Scale and Compasses.

Extend the Compasses from 144 to 192:1, that Extent will reach from 32.25 (half the Periphery of the Base) to 43.02 Feet, the Content of the upper Part.

And extend the Compasses from 144 to half the Perpendicular 9.31, that Extent will reach from the Side 21.5, to 1.39 Feet, the Area of the Base, which being added to the other, makes 44.41 Feet, the Content of the Whole.

Let A B C D E F G H be a Pyramid, whose Base is a

Heptagon, each Side thereof being 15 Inches, and the Perpendicular of the *Heptagon* is 15.58 Inches, and the Perpendicular Height of the Pyramid H I is 13.5 Feet; the Content Solid and Superficial is requir'd. See *Plate 2. Fig. 3.*

Multiply 15.58 (the Perpendicular) by 52.5. half the Sum of the Sides of the *Heptagon*, and the Product is 817.95, which multiply'd by 4.5. viz. $\frac{1}{2}$ of the Height, and the Product will be 3680.75.

Then divide this last Product by 144, and the Quotient will be 25.55 Feet, the Content.

15.58 the Heptagon's Perpendicular.
 52.5 the half Sum of the Sides.

7790

3116

7790

817.950

4.5 a third Part.

4089750

3271800

144)3680.7750(25.56 Solid Feet,
 288

800

720

807

720

877

864

13

By Scale and Compasses. To find the Superficial Content.

First, Find a Geometrical mean Proportional between 15.58 and 52.5 (as is before directed) which you will find to be 28.06; then extend the Compasses from 12 to 28.6, and that Extent will reach from 4.5 (twice turn'd over) to 25.56 Feet.

Multiply the Height taken from the middle of one of the Sides of the Base 162.75 Inches, by the half Sum of the Sides 52.5 Inches, and the Product will be 8544.375; which divided by 144, the Quotient will be 59.335 Feet, the Content of the upper Part.

P Y

162.75

52.5

81375

32550

81375

144)8544.375(59.335 Feet.

568 Base add

1344

483

517

855

135

65.015 the whole Content.

By Scale and Compasses.

Extend the Compasses from 144 to 162.74, and that Extent will reach from 52.5 to 59.335 Feet.

And extend the Compasses from 144 to 15.58 the Perpendicular of the *Heptagon*, and the Extent will reach from 5.25 to 5.68 Feet the Content of the Base; which add to the former, and the Sum will be 65.015, the whole Superficial Content.

PYRAMID [in *Architecture*] is a solid massive Edifice which from a Square Triangular, or other Basis, rises diminishing to a Point or Vertex.

Pyramids are sometimes used to preserve the Memory of singular Events; and sometimes to transmit to Posterity the Glory and Magnificence of Princes. But as they are a Symbol of Immortality, they are more commonly us'd as Funeral Monuments.

Such is that of *Cestius* at

P Y

144)817.95(5.68

979

1155

3

Rome, and those other celebrated ones of *Egypt*, as famous for the enormoufness of their Size as their Antiquity.

Those of *Egypt* are all square in their Bases, and it is a thing has been frequently propos'd, to establish a fix'd Measure from them, to be thereby transmitted to Posterity.

The Pyramid is said to have been among the *Egyptians* an Emblem or Symbol of human Life; the Beginning of which is represented by the Base and the End by the Apex, on which account it was they us'd to erect them on Sepulchres.

1. A Pyramid is one third of the perpendicular Altitude multiply'd by the Base.

2. The Superficial Area of a Pyramid is found by adding the Area of all the Triangles, whereof the Sides of the Pyramid consist, in one Sum.

3. The external Surface of a right Pyramid which stands on a regular Polygon Base, is equal

equal to the Altitude of one of the Triangles which compose it, multiply'd by the whole Circumference of the Base of the Pyramid.

A Pyramid should be raised to such a Height as may set it above all the Buildings that accompany it; so that it may be viewed out of the Country, and be a noble Ornament to the City that raised it.

A Pyramid, says *M. le Clerc*, should always be single, or alone, otherwise it looses its proper Signification, which is to represent the Glory of the Prince.

PYRAMIDAL Numbers, are the Sum of polygonal Numbers collected after the same manner as the polygon Numbers themselves are extracted from Arithmetical Progressions; they are distinguished into *first, second, or third Pyramidals*.

PYRAMIDOID, is what is sometimes called a *Parabolic Spindle*, and is a solid Figure, form'd by the Revolution of a Parabola round its Base or greatest Ordinate.

Q

QUADRA [*in Building*] is any square Border or Frame encompassing a Basso, Relievo, Pannel, Painting, or other Work: It is also us'd (but erroneously) for a Frame or Border of another Form, as round, oval, or the like.

QUADRANGLE [*in Geometry*] a Quadrangular or Quadrilateral Figure, or a Figure which has four Sides and four Angles. To the Class of Qua-

drangles belong, the *Square, Parallelogram, Trapezium, Rhombus, and Rhomboides*.

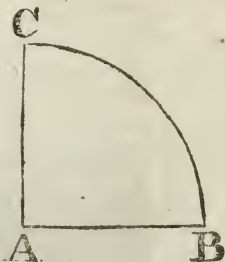
QUADRANT [*in Geometry*] is an Arch of a Circle containing 90 Degrees, or one 4th of the intire Periphery; and is also the Space contained between a quadrantal Arch and two Radii perpendicular one to another, in the Center of a Circle.

QUADRANT is the fourth Part of a Circle.

To find the *Area* this is

The R U L E.

Multiply half the arch Line of the Quadrant, (that is, the eighth part of the Circumference of the whole Circle) by the Radius, and the Product is the Area of the Quadrant.

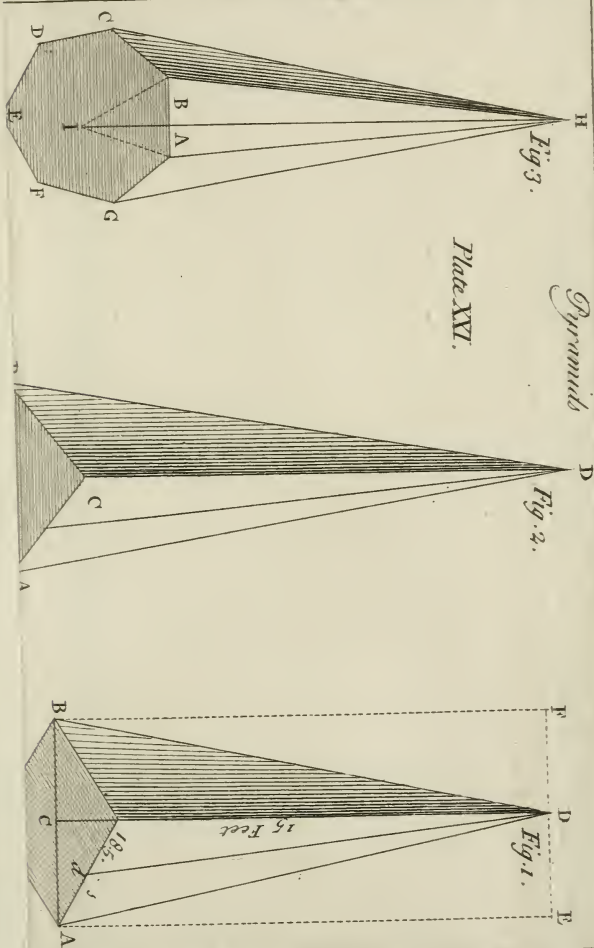


Let *ABC* be a Quadrant or fourth part of a Circle, whose Radius or Semiciameter is 11.3, and the half arch Line 8.875; these multiply'd together, the Product is 100.2875 for the Area.

These are the Rules and Ways commonly given for finding the Area of a Semicircle

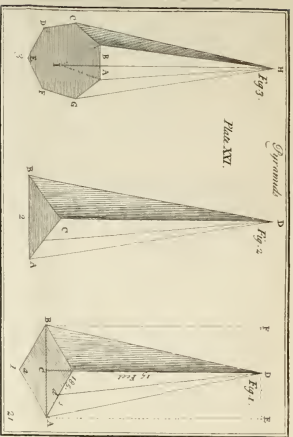
Dynamics

Plate XVI.



Pyramids

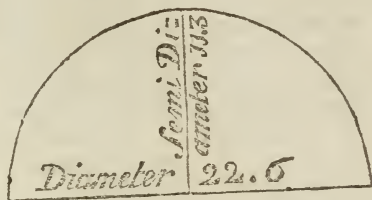
Plat. XVI.



and Quadrant; but I think it is as good a way to find the Area of the whole Circle, and then to take half that Area for the Semicircle, and a fourth part for the Quadrant.

To find the Area of a Semicircle, this is the RULE.

Multiply the fourth part of the Circumference of the whole Circle, (that is, half the arch Line) by the Semidiameter, and the Product will be the Area.



Let *ABC* be a Semicircle, whose Diameter is 22.6, and the half Circumference or arch Line *ACB* is 35.5, the half

of which is 17.75, which multiply by the Semidiameter 11.3, and the Product will be 200.575, the Area of the Circle.

$$\begin{array}{r}
 17.75 \\
 11.3 \\
 \hline
 5325 \\
 1775 \\
 1775 \\
 \hline
 \end{array}$$

200.575 The Area of the Semicircle.

By Scale and Compasses.

Extend the Compasses from 1 to 11.3, and that Extent will reach from 17.75 to 200.575, the Area.

If only the Diameter of the Semicircle be given, you may say by the Rule of Three, as 1 is to 3927, so is the Square of the Diameter to the Area.

By Scale and Compasses.

Extend the Compasses from

1 to the Diameter 22.6, and that Extent turned twice over from 3927, will reach at last to 200.575.

QUADRAT or Line of Shadows on a Quadrant, are only a Line of natural Tangents to the Arches of the Limb, and are plac'd there in order to measure Altitudes readily; for it will always be, as the Radius to the Tangent of the Angle of Altitude, at the Place of Observation (that is, to the parts of the Quadrats or Shadows cut by the

the String) so is the Distance between the Station and the Foot of the Object, to the Height above the Eye.

QUADRANTAL Triangle, is a Spherical Triangle, one of whose Sides (at least) is a Quadrant, and one right Angle.

QUADRATRIX [in *Geometry*] is a mechanical Line, by the Means whereof we can find right Lines equal to the Circumference of a Circle or other Curve, and the several Parts thereof.

QUADRATURE [in *Geometry*] is the squaring, or reduction of a Figure to a Square, or the finding a Square equal to a Figure proposed.

Thus the finding of a Square containing just as much Surface or Area, as a Circle, an Ellipsis, a Triangle, or other Figure, is call'd the *Quadrature* of a Circle, an Ellipsis, a Triangle, or the like.

The *Quadrature* of Rectilinear Figures comes under the common Geometry; as amounting to no more than the finding their Area's or Superficies, which are in Effect their Squares.

The *Quadrature of Curves*, that is, the measuring of their Area, or the finding of a rectilinear Space equal to a curvilinear Space, is a Matter of much deeper Speculation, and makes a Part of the higher Geometry.

QUADRATURE Lines are two Lines frequently placed on *Gunter's Sector*.

They are mark'd with the Letter Q, and the Figures 5, 6, 7, 8, 9, 10, of which Q

signifies the Side of a Square, and the other Figures the Sides of Polygons of 5, 6, 7, &c. Sides. S there stands for the Semidiameter of a Circle, and 90 for a Line equal to 90 degrees in the Circumference.

QUADREL [in *Building*] a sort of artificial Stone perfectly Square, whence their Name, made of chalky, white, pliable Earth, &c. dried in the Shade for two Years.

These were formerly in great request among the *Italian Architects*.

QUADRIPARTITION a dividing by four.

QUADRUPLE a Sum or Number multiply'd by 4, or taken four times.

QUADRILATERAL Figures, are those whose Sides are four Right Lines, and those making four Angles, as *Parallelogram, Trapezium, rectangle Square, Rhomboides or Rhombus*.

QUANTITY signifies whatsoever is capable of any Sort of Estimation or Mensuration, and which being compar'd with another thing of the same Nature, may be said to be greater or less, equal or unequal to it.

The Quantity of Matter in any Body, is its Measure arising from the Joint Consideration of its Magnitude and Density.

2. The Quantity of Motion in any Body, is its Measure arising from the Joint Consideration of the Quantity of Matter in, and Velocity of the Motion in that Body.

QUARRELS of Glass } [in
QUARREYS } *Gla-*
ziery]

ziery] a Pane or Piece of Glass cut in a Diamond Form.

They are of two Kinds, *viz.* Square and Long, each of which is of different Sizes, express'd by the Number of them which makes a Foot, *viz.* 8ths, 10ths, 12ths, 15ths, 18ths and 20ths; but all the Sizes are cut to the same Angles, the Acute Angle being 77 Degrees 19 Min. in the Square Quarrels, and 67 Degrees 21 Minutes in the Long ones.

QUARRY, a Place under Ground, out of which are dug Marble, Free-stone, Slate, Lime-Stone, and other Matters proper for Building.

In the digging Quarries of *Free-stone*, they first open a Hole in the Manner of a Well, 12 or 14 Foot in Diameter, drawing up the rubbish with a Windlass in large Osier Baskets, they heap it up all around, and Place the Wheel, which is to draw up the Stones upon it.

As the Hole grows deeper, and their common Ladder too short, they apply a particular Ladder for their Purpose: when they are got through the Earth, and are arrived at the first Bank or *Stratum*, they begin to use their Wheel and Baskets, to discharge the Stones as fast as they dig through them.

There are usually seven of these different Beds or Strata of Stones found of different Heights and serving for different Purposes; tho' the Number, as well as the Order in which they follow, is various.

As to the drawing of the Stone, *i. e.* freeing it from the Beds,

they find that common Stones, at least those that are of the softer Kinds, as they lie, have two Grains, a cleaving Grain, running Parallel with the Horizon, and a breaking Grain, Perpendicular thereto.

After they have uncop'd the Stone, *i. e.* cleared it of the Earth, they observe by the Grain where the Stone will cleave, and there they drive in a good Number of wedges, till they have by this Means clear'd it from the Rest of the Rock.

They then proceed to break it; in Order to which they apply a Ruler to it at both Ends about 10 or 12 Inches apart, according to the Uses the Stone is intended for, and strike a Line, and by this cut a little Channel with their Stone Ax; and set five or six wedges, (supposing the Stone to be three or four Foot) driving them in very carefully, with gentle Blows, and still keeping them equally forward.

When they have broke them in Length (which they are able to halt an Inch of any Size) applying a Square to the Streight Side, they Strike a Line and proceed as before to break it in Breadth also.

This Method of drawing is found greatly preferable to that where the Stones are broken at Random, one Load of the Stones drawn after this Manner, being found to do the Business of a Load and a Half of the latter.

But this cleaving Grain being seldom found in the harder Stones they use great heavy Stone Axes only for breaking up these
in

in the Quarries, with which they Work down a deep Channel into the Stone, and lay two Bars of Iron a Top into this Channel, and drive their Iron Wedges between these Bars.

Some, in drawing of Stone, especially those of a very hard Kind, make use of Gunpowder, and to a very good Effect.

Their Method is as follows, they make a small Perforation pretty deep into the Body of the Rock, so as to have that thickness of Rock proper to be blown up at once; at the further End of the perforation they lay a proper Quantity of Gunpowder, filling up all the Rest with Stones and Rubbish strongly ramn'd in, except a little Space for the Train.

By this Means is the Rock blown up into several Pieces, most of them not too unwieldy for the Workmen to manage.

QUARTER Round [in *Architecture*] signifies any Moulding in general, whose contour is either a perfect Quadrant or Quarter of a Circle, or that approaches near to that Figure. Architects commonly call it *Ovolo*, and *Vitruvius Echinus*.

QUARTERS [in *Architecture*] are those slight upright Pieces of Timber placed between the Punchions and Posts, used to lath upon.

They are of two Sorts, *single* and *double*; the *single* Quarters are sawn Stuff two Inches thick and four Inches broad; the *double* Quarters are sawn to four Inches Square.

'Tis a Rule in Carpentry, that no Quarters be placed at greater Distance then fourteen Inches.

QUARTERING [in *Carpentry*] signifies the putting in of Quarters. Sometimes it is used for the Quarters themselves.

QUINDECAGON, is a plain Figure of fifteen Sides and Angles, which, if they are all equal to one another, is call'd a *regular Quindecagon*.

Euclid shows how to describe it in a Circle. *Prop. 16. c. 4.*

The Side of a *regular Quindecagon* so described is equal in Power to the half Difference, between the Side of equilateral Triangle, and the Side of the *Pentagon*; and also to the Difference of the Perpendiculars let Fall on both Sides taken together.

QUINQUEANGLED [in *Geometry*] is said of a Figure consisting of five Angles.

QUINTUPLE five Fold or five Times as much as another Thing.

QUIRK [with *Builders*] a Piece of Ground taken out of any Ground Plot or Floor----- Thus if the Ground Plot were Square or Oblong, and a Piece be taken out of a Corner to make a Court or Yard, &c. the Piece is call'd a Quirk.

QUOINS [in *Architecture*] are set in the Corners of Brick, or Stone Walls.

The Word is particularly used for Stones in the Corners of Brick Buildings.

Rustick-Quoins, are those which stand out beyond the Brick

Brick Work, (their Edges being chamfer'd off.)

These latter at two Foot one Face, and one Foot the other, are valued from 1 s. to 1 s. 4 d. per Quoin, Stone and Workmanship.

QUOTIENT [in *Arithmetick*] is that Number in a Division, which arises by dividing the Dividend by the Divisor; and is call'd the *Quotient*, because it answers to the Question, how often one Number is contain'd in another.

R

RABBETING [in *Carpentry*] is the planing or cutting of Channels or Grooves in Boards.

RAFTERS [in *Building*] are pieces of Timber, which stand by Pairs upon the Reason, meet in an Angle at the Top, and help to compose the Roof of a Building.

As to their Scantlings, &c. it is provided by an Act of Parliament for Re-building the City of *London*, that the following Scantlings, (which were well consulted by the ablest Workmen before they were reduced to an Act) are set down as fitted for all Edifices great or small, as follows.

As to their Distance, 'tis a Rule in *Architecture*, that no Rafters be laid at greater Distance from each other than 12 Inches.

Principal Rafters in Length.	From		to		Must be in Breadth.		And thick.
	F.	I.	F.	I.	Foot.	Top.	
	12	6	14	6	Inches	Inches	Inches..
	14	6	18	6	8	5	6
	18	6	21	6	9	7	7
	21	6	26	4	10	8	8
	24	6	26	4	12	9	8 $\frac{1}{2}$
					13	9	9

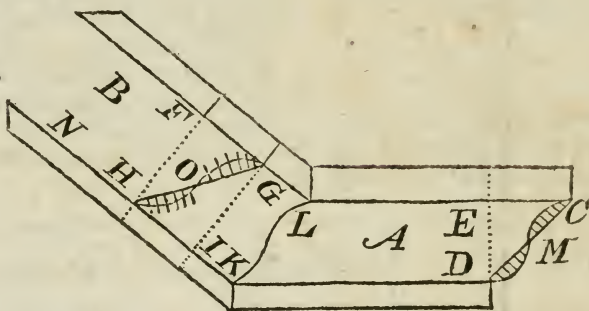
Single Rafters in Length — { 6 Foot 6 Inches
8 next
9 next } must
have in their Square — { 4 and 3
4 $\frac{1}{2}$ and 3 $\frac{3}{4}$
5 and 4 } Inches

Principal R A F T E R S, should be near as thick at the Bottom as the Beam, and should diminish in their Length one fifth, or one sixth of their Breadth, the king Posts should be as thick as the principal Rafter, and their Breadth according to the Bigness of them that are intended to be let into them, the middle Part being left something broader than the Thickness.

RAG-STONE, see *Paving*.

RAKEING. Suppose the Level Moulding A join the racking Moulding B. How to make their Curves to fit each other at their Mitring L K.

Draw the Moulding or Curve C D, also the Right Line C D, which divide into halves in M, and divide the Right Line D M and M C, each into any Number of equal Parts (the more the better,



From thence raise Perpendiculars to the Curves, as in the Example; and draw the Line D E Perpendicular to D K.

When you have done this, draw the Line GI and HF Perpendicular to KN , and distant from each other, equal to EC , and draw the Line HG , which divide in the middle in O .

Then divide HO into the same Number of Parts as DM , and also OG as MC , from whence raise Perpendiculars at Pleasure, as in the Example.

When you have so done, take the Length of the Perpendiculars between the Right Line and the Curve Line D M, and set

them on their respective Perpendiculars on the Right Line H O; that is, set the Line next to D on the Line next H; and so on to the Perpendiculars on M C and O G, whose Points create the true Curve H O G, by sticking a Nail into each Point, and bending a thin Lath to touch them all at once, whose Edge gives the Curve or moulding requir'd.

N. B. This Method is useful in all Pediments or Raking Work whatsoever, and will prevent that common Error, which Workmen call tuning off, after the Work is put together.

RAILS [in *Architecture*] are used in different Senses, as particularly for those Pieces of Timber, &c. which lie horizontally between the *Pannels* of Wainscot; also for those which lie over and under Ballusters in Balconies, Stair-cases, and the like; and also to pieces of Timber, which lie horizontally from Post to Post in Fences, with Pales or without.

Mr. *Wing* says, that the Price of making Rails and Ballusters on Balconies, or about the Platform of great Houses are worth (for Workmanship only) 4s. per Yard, running Measure.

RAISER [in *Building*] a Board set on Edge, under the fore-side of a Step, Stair, &c.

RAISING Pieces [in *Architecture*] are Pieces that lie under the Beams, on Brick or Timber by the Side of the House.

RANGE [in *Building*] the Side of any Work that runs strait, without breaking out into Angles, is said to range or run range: Thus the Rails and Pannels of one Side of wainscoting is said to run range.

RATIO or **REASON** [in *Arithmetick* and *Geometry*] is that Relation of homogeneous Things which determines the Quantity of one from the Quantity of another, without the Intervention of any third: Or it is when two Quantities are compar'd one with another, with Respect to their greatness or smallness, that Comparison is called *Ratio*.

RATIONAL Quantity or

Number, is a Quantity or Number commensurable to Unity.

As, supposing any Quantity to be 1, there are infinite other Quantities, some of which are commensurable to it, either simply or in Power, and these are called by *Euclid Rational Quantities*; and the rest that are incommensurable to 1, he calls *Irrational Quantities*.

RATIONAL Integer, or *Whole Number*, is that of which Unity is an Aliquot Part.

RATIONAL Fraction or *Broken Number*, is that which is equal to some Part or Parts.

RATIONAL Mix'd Number, is that which consists of a Mix'd Number and a Fraction.

RAY [in *Opticks*] a Line of Light propagated from a Radiant, through an unresisting Medium.

Common RAY [in *Opticks*] is sometimes us'd for a Right-line drawn from the Point of the concurrence of the two optical Axes, through the middle of the Right-line, which passes by the Center of the Pupil of the Eye.

PRINCIPAL RAY [in *Perspective*] is the perpendicular Distance between the Eye and the vertical Plane or Table, as some call it.

RECIPROCAL Figures [in *Geometry*] are such as have the Antecedents and Consequents of the Ratio in both Figures.

RECIPROCAL Proportion is when in four Numbers, the fourth is lesser than the second, by so much as the third is greater than the first; and *vice versa*.

RECTANGLE [in *Arithmetick*] is the same with Product, which see.

RECTANGLED, as a *Rectangled Triangle*, is a Triangle one of whose Angles is Right or equal to 90 Degrees.

There can be but one Right-angle in a Plain Triangle; therefore a rectangled Triangle cannot be equilateral.

RECTANGULAR [in *Geometry*] is applied to Figures and Solids, which have one or more Angles right.

RECTILINEAR [in *Geometry*] i. e. *Right lined*, is applied to Figures, whose Perimeter consists of Right-lines.

REDUCT [in *Building*] a Querk or little Place taken out of a larger, to make it more uniform and regular: or for some Conveniencies, as for little Cabinets on the Sides of Chimneys, Alcoves, &c.

REDUCTION [in *Arithmetick*] is the converting Monies, Weights and Measures, into the same Value in other Denominations, ex. gr. Pounds into Shillings and Pence, &c.

REFLECTION in general, is the Regress or Return, that happens to a moving Body, because of the meeting of another Body, which it cannot penetrate; thus the material Rays are reflected variously from such Bodies as they cannot pass through.

REFLEX } [in *Paint-*
REFLECT } *ing*] is understood of those Places in a Picture, which are supposed to be illuminated by a Light, reflected by some other Body re-

presented in the same Piece.

REFLEX Vision } [in
REFLECTED Vision } *Ca-*
toptricks] is that which is performed by means of Rays reflected from polish'd Surfaces of Objects to the Eye.

REFRACTION [in *Mechanicks*] in General, is the Incurvation or change of Determination in the Body moved, which happens to it while it enters or penetrates any Medium.

REFRACTION [in *Dioptricks*] is the Variation of a Ray of Light, from that Right-line which it would have passed in, had not the Density of the Medium turn'd it aside.

REFRACTION *from the Perpendicular*, is when a Ray falling inclin'd, from a thicker Medium into a thinner, in breaking departs from that Perpendicular.

REFRACTION *to the Perpendicular*, is when it falls from a thinner into a thicker, and so becomes nearer the Perpendicular.

REGULA [in *Architecture*] See *Orlo*.

REGULAR BODIES are Solids, whose Surface is compos'd of regular and equal Figures; whose Solid Angles are all equal, such as the *Tetrahedron*, *Hexahedron*, *Octahedron*, *Dodecahedron*, and *Icosahedron*.

There can be no more regular Bodies besides these.

REGULAR Figures [in *Geometry*] are such whose Sides, and consequently their Angles, are all equal to one another: Whence all regular Multilateral Planes

Planes are called *Regular Polygons*.

The Area of such Figures is speedily found, by multiplying a Perpendicular let fall from the Center of the inscrib'd Circle to any Side, by half that Side; and then that Product by the Number of the Sides of the Polygon.

RELIEVO } [in *Sculpture*
RELIEF } is applied to a Figure which projects or stands out, prominent from the Ground or Plane whereon it is form'd; whether that Figure be cut with a Chissel, moulded or cast.

The *Alto Relievo* } is when High RELIEF } the Figure is form'd according to Nature, and projects as much as the Life.

Basso RELIEVO }
Bass or low RELIEF } is when the Work is rais'd but a little from its Ground, as in Medals, Frontispieces, Festoons, Foliages, and other Ornaments of Friezes.

Demi RELIEVO, is when one half of the figure rises from the Plan, *i. e.* when the Body of the figure seems cut in two, and the one half of it is clapp'd upon a Ground, when there are some Parts that stand clear out, detach'd from the rest in a *Basso Relievo*, then the Work is called *Demi-Bass*.

RELIEVO [in *Architecture*] is the Projecture of any Ornament.

Daviler observes, that this ought always to be proportion'd to the Magnitude of the Building it adorns, and the Distance at which 'tis to be viewed.

RELIEVO [in *Painting*] is a Degree of Force or Boldness wherewith the Figures seem at a due Distance, to stand out from the Ground of the Painting, as if they were really imboss'd.

RENDERING [in *Building*] See *Pargetting*.

REPOSITORY, a Store-house, or Place where things are laid up and kept. *Architects* more particularly use it to signify such a Place as is built for the laying up Rarities, either in Painting or any other Art.

RESERVATORY, a Place to which Waters are brought together, not only to make *Fets d'eaux* one of the greatest Ornaments of a Garden; but also for supplying a noble Seat with Water for Family Uses. See *Reservoir*.

If a Person shall be so happy as to find out Water in a Place for which he may conveniently make a Reservoir, without the Help of Machines, much Expence will be sav'd thereby: But if that be impossible to be done, of Necessity Recourse must be had to *Hydraulick* Machines, in order to raise it from the Bottom of Pools into *Reservoiries*, that it may be afterwards let down into Gardens, Houses, &c.

These Machines are now much in Use, and many People prefer them before natural Water-Courses, by Reason of the Quantity of Water they furnish, and the nearness of the *Reservoiries*, and Conduits or Pipes.

Water is rais'd by different Machines; first, by Pumps and Horses; and Secondly the two Elements of Air and Water are us'd to turn Mills, and these are infinitely to be preferr'd; these Machines almost always furnishing us with Water, as may be said, Night and Day.

Those *Reservatories* that are made on the Ground are usually Parcels of Water or moist Channels, from whence the Waters are brought together in great Quantities; these are made deep, that they may contain the more, and not be so soon empty.

If these can be made near an House, it will be much better; but if there be a Necessity that the *Reservatory* be in the Fields, it must be surrounded with a Wall.

Those *Reservatories* that are rais'd above Ground, cannot be expected to be made as large as the others, nor of Consequence be capable of holding as much Water; the Difficulty to support them, and Charge of the Lead, wherewith to line them, not admitting of it; they are to be rais'd upon Arches or Stone Pillars, with Timber Work thercon to form the Bottom and Sides, which must be lin'd with strong Sheets of Lead, well soldered together. The Timber Work ought to be very solid and strong, that it may bear the great Weight of the Water.

The Ancients had 3 Ways for the Conveyance of Water, viz. Subterranean Aqueducts, Leaden Pipes, and Stone or

Earthen Pipes; which are still in Use, and to which we may add those of Wood, Brass and Copper.

Subterranean Aqueducts ought to be built of Free-Stone, and cover'd over with Arches or flat Stones, to the End that the Sun may not have an Influence upon the Water: If a Rock happens to be in the Way, it must be cut thorough, and if a Mountain obstructs the Passage, a Way must be made through it, and the Aqueduct must be carried on through them, and Props us'd of 50 Fathom long from Place to Place, in Order to give the Water a little Air; and as to the Bottoms and Vallies which interrupt the Level of the Conveyance, they are to be fill'd up with Rubbish and Heaps of Masonry, or with Arches and the like.

The Water runs into these Aqueducts after different Ways, either through Stone or Leaden Pipes, Free-Stone, Troughs, Trenches made of Lime and Cement or Clay.

There are sometimes Veins of Gravel or Gravel Stones naturally met with, through which the Water will run without any loss: Room ought always to be made or allow'd for two small Paths on each Side of these Troughs or Conveyances, that there may be a Passage along by them, if there be Occasion; and besides, there must an imperceptible Declivity be given to these Troughs, that the Water may the more easily run along.

These

These Sorts of Aqueducts are proper to collect Spring Water, and to convey it into a *Reservatory*; for the Waters being not clos'd up therein, as in Pipes, they lose the Declivity and the Force which they ought to have to mount up into the Air.

Leaden Pipes are the most commodious for raising of Water; you may make them rise, fall and turn, without hurting the running of the Water thro' them: There are two Sorts of them, *viz.* cast and soldered Pipes.

The first are cast in Moulds; of what Length you please, and are generally 12 Foot long; they are made thicker than the solder'd ones, for Fear of Blows; and therefore are better and more valued; but they cost more by reason of their Weight.

Soldered Pipes are only Sheets of Lead, bended and soldered together at the Junctures, the biggest Leaden Pipes not exceeding six Inches Diameter; these are thrust into one another and soldered: These are apt to burst and to waste, laid in Earths that are full of Chalk.

Stone or Earthen Pipes was a third Way the Ancients had for the Conveyance of Water, and are those that cost the least and yet will keep the best.

These Pipes are a Composition of baked Earth, like that of which they make earthen and Stone Pots; they join the Bodies of them, which are two or three Feet long to one another; and make Use of

Mastick with some Hemp or Flax for the Junctures.

When these Pipes are made Use of for the Conveyance of forc'd Waters, they encompass them with a Lay of Cement, five or six Inches thick, which will preserve them a long time, provided they have the Precaution; first, to let the Conduit dry for several Months, before the Water is turn'd into it; that so the Cement may have Time to harden: And secondly, to secure these Pipes which are very brittle, with some Brick Work, so that they may not sink down too much.

These Pipes are more proper for the Conveyance of the Discharges of Basons, than spouting Water, which they cannot long be able to bear; they are subject to Fox-Tails, which are very small Roots, which passing through the Pores of the Earth or Stone, or through the Mastick which rots in the Ground, are fed by the Water and become so thick and long, that they intirely stop the Pipe.

There are some who pretend that the Fox-Tail comes from the Hemp that is us'd with the Mastick for the Junctures, or else from some Seeds, which with the Water got into the Pipe.

Stone or Earthen Pipes are particularly valued, for the Conveyance of Spring Water to drink; for being glaz'd on the inside, the mud will not stick to them, and the Water is better preserv'd and clearer than in other Pipes; besides that it does not acquire that ill

Quality in passing through them, as it does through Lead or Iron.

For making wooden Pipes, they take large Trees of Oak, Elm or Alder, and the straightest that can be got; they bore them thorough and make a Channel of three or four Inches Diameter: they frame them after such Manner, that the End of the one may be thrust into the other, and bind them with an Iron Hook or Circle, and cover the Junctures with Pitch.

These Sort of Pipes are good in Marshy Grounds, and such as are naturally moist; for they soon perish in those that are dry.

The Water that passes thro' them, M. *Chomel* says, is of a dark red Colour, and has always a particular Taste.

Iron Pipes are cast in Moulds, and are now much us'd; they have the same good Qualities as those of Lead; they will last long, and cost four or five times less Money.

Some of them are made to 18 Inches Diameter; each Pipe is three Foot and a half long, and there are Bridles at each End of them, which are join'd and clos'd together by Screws and Worms, between which they put Roundels of Leather and Mastick.

As to the Proportion and Bigness of the Conduits and Pipes, in Reference to the *Jet d'Eau* or throwing of Water. it is upon that the Beauty of Spouting Water depends; for if the Pipes are too small, or

that they furnish the Basons with too much Water, without a just Proportion, they will form small, weak and ill fed Casts; besides these Pipes are subject to be easily choak'd up and to burst.

Now to play a *Jet d'Eau* of four or five Lines, that is one whose Ajutage is four or five Lines Diameter, which forms a Passage of an Inch and the seventh Part of an Inch in Circumference, you must have a Pipe of an Inch and a half Diameter: For a *Jet d'Eau* of six or seven Lines, you must have a Pipe of 2 Inches; for one of eight or nine Lines, a Pipe of three Inches; and for a large *Jet d'Eau* of an Inch, a Pipe of four Inches Diameter, and for a larger *Jet d'Eau* of 15 or 16 Lines, you must have a thick Pipe of six Inches Diameter.

It should be held for a general Rule, that the Passage or Mouth of the Ajutages, should be four times less than the Opening or Diameter of the Pipes of the Conduit; to the End that the Pillar of Water may be proportioned, and that the Swiftmess in the Pipes may be equal.

Add to this, that there must be too great a Friction in the small Conduits with Regard to great Ajutages, and in the Brink or Edge of some Ajutages, in reference to large Conduits.

Note, that 12 Lines make an Inch.

There are several Sorts of Ajutages; but the most common

mon are rais'd ones, and such as have but one Mouth or Passage; and they are also the best, and do not stop so often as the flat ones; which are pierced with several Holes or Clefts, plac'd opposite to one another, or else they folder on several other small Ajutages.

It is certain, that the larger the Conduits or Conveyance are, the better the Water passes; it is the Soul of good *Jets d'Eau*, which that they may be well fed, should have a Conduit of the same Bigness, thro'out from the *Reservatory* to the *Ajutage*, without Diminution. This will furnish more Water, and give more Vigour to the *Jet* or Cast, which without will, as it were, be choak'd up afar off.

Some indeed are of a contrary Opinion, and maintain that in a Conveyance of 100 Fathom long, it ought to be bigger in the first 50 next the *Reservatory*, than in the other 50 reaching to the *Ajutage*; and they pretend that the Diminution of the Bigness, should be about an Inch Diameter; to the End, say they, that the Water may begin to be forced, and pent at a little Distance in the Pipe, and which should always run with some Diminution to the very out-let of the Water. But others again say, that they have no solid Reason to support their Fancies.

There is but one Case only wherein the Diameter of the Conveyances ought to be diminish'd; and that is, when they are so long as three or

four hundred Fathom; then the Pipes are to differ thrice in Bigness, for without it, in the long Course the Water is to run, it will, as it were, sleep, and lose much of its Strength; but on the Contrary, the different Sizes revive and actuate it.

For Example, A Conduit that is 300 Fathom long, should have the first hundred of eight Inches Diameter, the next of six, and the last of four Inches Diameter.

But in those Conveyances or Pipes of 100 or 150 Fathom, you must continue the same Diameter throughout the whole Length, even to the *Ajutage*.

When there are several *Jets d'Eau*, as suppose five or six to be play'd in a Garden, it is not necessary that there should be five or six Conveyances or different Pipes made from the *Reservatory*, it would be a superfluous Charge, and contrary to all good Oeconomy: two or three are enough; but they must be of such Proportion and Bigness, as to be sufficient to supply all these *Jets d'Eau* with Water, in such a Manner that they may play all together equally, and without falling lower than one another.

Now to play three *Jets d'Eau*, each of which is from six to seven Lines in Diameter, your Pipe must be six Inches; and for three *Jets d'Eau* of four Lines, the Pipe must be four Inches; the Pipe they continue of the same Bigness till over against the Basons, or they diminish it proportionably by

Branches; and thus in a Pipe of six Inches, they make Branches of two Inches Diameter, to the End that the Water may be equally distributed for the Out-lets.

It is to be observ'd, that the End of the Pipe next the *Reservatory*, ought to be two Inches or more in Diameter than the Rest: for Example, if a Pipe be four Inches in Diameter, the Sucker or Opening must be six Inches in the Bottom of the *Reservatory*, to the End that the Entrance being larger, it may serve for a Funnel for the Water to enter in more readily, and yield a greater Supply to the *Fets d'Eau*, you must make a Regard or Head, that is answerable in Bigness to the Diameter of the Pipe; and take Care that as much Water passes through the oval Hole of the Spout, and what some call the Bushel, as thro' the circular Hole of the Pipe.

RESERVOIR, a Place where Water is collected and reserv'd to be convey'd occasionally through Pipes, &c. or to be spouted up, &c.

The *Reservoir* is a Building or large Basen, usually of Wood lin'd with Lead, where Water is kept to supply the Occasions of the House.

At *Canons*, the noble Seat of the Duke of *Chandois*, is a very large *Reservoir*, a Top of the House, to which the Water is rais'd by a very curious Engine, contriv'd for the Purpose.

This *Reservoir* is so capa-

cious, as that besides supplying all Parts of the House by Means of Pipes and Cocks, it likewise turns a Mill.

A *Reservoir* is also sometimes a large Basen of strong Masonry, glazed or paved at the Bottom: where the Water is reserv'd to feed *Fets d'Eau* or spouting Fountains.

Such is that vast one on the Top of *Marli* in France, call'd *Trou d'Enfer*, i. e. Hell-Mouth, whose Surface, *Daviler* tells us, contains 50 Acres, and its Depth such as under that Superficies to contain 100000 Cubick Fathom of Water.

RESOLUTION [in the *Mathematicks*] is a Method of Invention, whereby the Truth or Falshood of a Proposition, or the Impossibility is discovered, in an Order contrary to that of Synthesis or Composition.

RESSAUT [in *Architecture*] is the Effect of a Body, which either projects or sinks, i. e. stands more out or in than another; so as to be out of the Line or Level with it.

RETURN [in *Building*] is a Side or Part that falls away from the foreside of any strait Work.

RIBBING Nails, see *Nails*

RHOMBOIDES [in *Geometry*] a Quadrilateral figure, whose Sides and Angles are unequal, but the opposite ones equal; but is neither equilateral nor equiangular. Or,

A **RHOMBOIDES** is a Figure having four Sides, the opposite whereof are equal and parallel; and also four Angles, the opposite of which are equal,

To find the Superficial Content.
The R U L E.

Multiply one of the longest Sides of it, by the Perpendicular let fall from one of the Obtuse Angles to one of the longest Sides, and the Product will be the Content.

$$\begin{array}{r}
 19.5 \\
 10.2 \\
 \hline
 390 \\
 195 \\
 \hline
 19830
 \end{array}$$

Let ABC be a Rhomboides given, whose Sides AB or CD is 19.5 Feet, and the Perpendicular AE is 10.2, which multiply together, the Product is 198.9, that is 198 Superficial Feet, and 9 tenth Parts the Content. See the Plate, Fig. 1.

Demonstration.

If BC be extended to F , making CF equal to DE , and a Line be drawn from B to F , so will the Triangle CBE be equal to the Triangle ADE , and the Parallelogram $AEFB$ be equal to the Rhomboides $ABCD$, which was to be proved. Plate 1. Fig. 1.

To describe the Rhomboides $ABCD$, whose Angle at G shall be equal to the given Angle HGI , its longest Sides each equal to the given Line KK , and its shortest each equal to the Line EM .

First, Make CD equal to KK , and make the Angle C

equal to the Angle HGI , and make CA equal LM .

Secondly, On A with a Radius CD describe the Arch EE , and on D with a Radius CA , describe the Arch FF , intersecting the Arch in EE in B .

Thirdly, Join AB and BD , and the Rhomboides is completed as required. Plate 1. Fig. 2.

RHOMBUS [in Geometry] is an obliquangular Parallelogram, or a quadrilateral Figure whose Sides are equal and parallel, but the Angles unequal, two of the opposite ones being Obtuse, and the other two Acute. Or,

RHOMBUS is a Figure representing a Quarry of Glass, having four equal Sides, the opposites of which are equal, two of its Angles being Obtuse and two Acute.

To find the Superficial Content.
The R U L E.

Multiply one of the Sides by a Perpendicular let fall from one of the obtuse Angles to the opposite Side, and the Product is the Content.

$$\begin{array}{r}
 \text{Perpend. } 13.42 \\
 \text{The Side } 15.5 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 6710 \\
 6710 \\
 1342 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 \text{Product } 208.010
 \end{array}$$

Let $ABCD$ be a Rhombus given, whose Sides are each 15.5 Feet, and the Perpendicular EC is 13.42, which multiply'd together

together, the Product will be 208.010; which is the Superficial Content of the *Rhombus*.

By Scale and Compasses.

Extend the Compasses from 13.42, that Extent will reach from 15,5 the same way to 208 Feet, the Content.

Demonstration:

Let CB be extended out to F , making DF equal to GD and draw the Line BF ; so shall the Triangle DBF be equal to the Angle ACE : For DF and CE are equal, and BF is equal to AE , because AB and CF are parallel; therefore the Parallelogram $ABEF$ is equal to the Rhombus $ABCD$. See *Plate 1. Fig. 2.*

To delineate a RHOMBUS, whose Sides shall be equal to a given Line AB .

Make DC equal to AB , then on C with the Radius DC , describe the Arch DEF , and make DE and EF equal to DC .

2. Join DE , EF , and FC and the Rhombus is compleated as requir'd.

Note. That as the Angles of this Figure are all oblique, viz. the Angles LH acute, and KI obtuse, therefore their Diagonals LH and KI are unequal, viz. LH is longer than KI , notwithstanding that the Sides are all equal as in the Geometrical Square. Therefore if a Geometrical Square hath any two of its opposite Sides put out of a perpendicular Position, so as to alter their Right Angles, it instantly becomes a Rhombus or Diamond Form.

RIDES, Hinges for Doors.

RIDGE [in *Building*] the highest Part of the Roof or Covering of a House.

RIDGE Tiles, See *Tiles*.

RIGATE Stones, See *Free-Stones*.

RIGHT [in *Geometry*] Something that lies evenly, and without inclining or bending the one way or the other.

RIGHT Angle, is that form'd by two Lines, falling perpendicularly one on another.

RIGHT Angled, is understood of a Figure, when its Sides are at Right-angles, or stand perpendicularly one upon another.

ROD, a Measure of Length, containing by Statute sixteen Foot and a half *Englisch*.

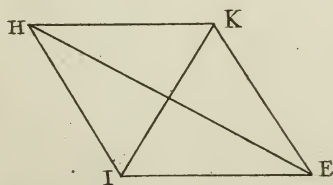
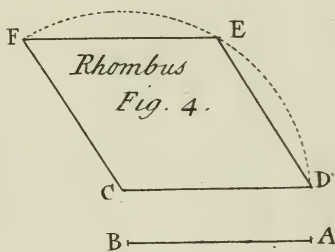
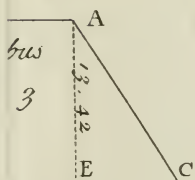
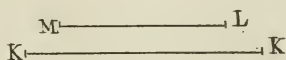
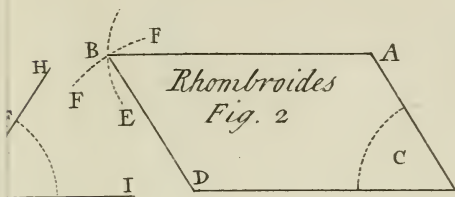
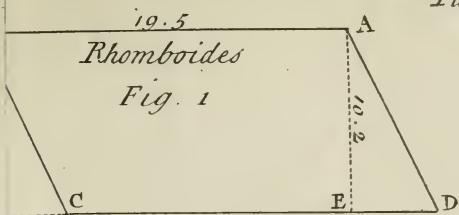
ROLLERS } [with *Car-*
ROLLS } *penters, Ma-*
sons, &c.] are plain Cylinders of Wood, seven or eight Inches in Diameter, and three or four Foot in Length, us'd for the removing of Beams, huge Stones, or other like Burthens; which are cumbersome, but not exceeding heavy.

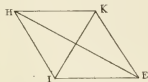
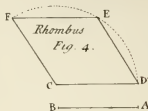
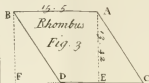
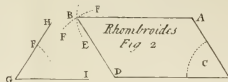
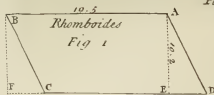
These Rollers are plac'd successively under the fore-part of the Massives or heavy Bodies to be remov'd; which at the same Time are push'd forward by Levers &c. apply'd behind.

Endless ROLLERS are us'd when they are to remove Blocks of Marble, or other excessive heavy Loads.

To give these the greater Force, and prevent their Bursting they are made of Wood jointed together by cross Quarters, being about twice the Length of

com-





common *Rollers*, and girt with several large Iron Hoops at each End.

At about a Foot Distance from the Ends are four Mortises, or rather but two; but pierced through and through; into which the Ends of long Levers are put, which the Workmen draw by Ropes fasten'd to the End; still changing the Mortise, as the Roller has made the quarter of the Turn.

ROLLING [in *Mechanicks*] *i. e.* Revolving, is a Kind of Circular Motion, wherein the moveable turns round its own Axis or Centre, and continually applies new Parts of its Surface to the Body it moves upon.

The Motion of *Rolling* is oppos'd to that of *Sliding*, in which the same Surface is continually apply'd to the Plane it moves along.

The Friction of a Body in *Rolling*, or the Resistance made to it by the Roughness of the Plane it moves on, is found to be much less than the Friction in sliding,

Hence is the great Use of Wheels, *Rollers*, &c. in Machines as much of the Action as possible, being laid thereon to make the Resistance the less.

ROMAN Order [in *Architecture*] is the same with the *Composite*. It was invented by the *Romans* in the Time of *Augustus*, and set above all others, to shew that the *Romans* were Lords over other Nations; it is made up of the *Ionic* and *Corinthian Orders*.

ROOF [in *Architecture*] is the

uppermost Part of a Building.

The Roof contains the Timber Work and its Covering of Slate or Tile, or whatsoever serves it as a Cover, tho' Carpenters usually restrain *Roof* to the Timber Work only.

The Form of *Roofs* are various, sometimes pointed; in which Case, the most beautiful Proportion is, to have its Profile an equilateral Triangle.

A *Square Roof*, is that where the Angle of a Roof is a Right Angle, which therefore is a mean Proportional between the *Pointed* and

Flat Roof, which is in the same Proportion as a Triangular Pediment. This is chiefly us'd in *Italy* and the hot Countries where little Snow falls.

Sometimes *Roofs* are made in the Pinnacle Form.

Roofs have sometimes a *double Ridge*, and sometimes *mutilated*, *i. e.* they consist of a *true* and a *false Roof*, which is laid over the former.

This last is particularly called a *Mansard*, from M. *Mansard*, a famous *French Architect*, the Inventor; sometimes they are in the Form of a *Plat-Form*, as most of the Eastern Buildings are.

Truncated Roof is one, which instead of terminating in a Ridge or Angle, is cut square off at a certain Height, and cover'd with a Terrace, and sometimes encompass'd with a Ballustrade.

Sometimes a *Roof* is made in the Manner of a *Dome*, that is, having its Plan square, and the Contour circular.

Round

Round Roof, is that where the Plan is round or oval, and the Profile a direct Descent.

Sometimes the Base being very large, is cut off to diminish its Height, and is cover'd with a Terrass of Lead rais'd a little in the middle, with Sky - Lights from Space to Space, to give Light to some *Corridore*, or other intermediate Pieces, which without such an Expedient would be too dark.

When the Walls have been rais'd to their design'd Height, the Vaults made, the Joists laid, the Stairs, &c. brought up, then the Roof is to be rais'd, which embracing every Part of the Building, and with its Weight equally pressing upon the Walls, is as a Band to all the Work, and besides, defends the Inhabitants from Rain or Snow, the burning heat of the Sun; and the Moisture of the Night, adds no small Help to the Building, by casting off the Rain Water from the Walls, which altho' it seems at present to do but little Hurt, yet in the Process of Time, is the Cause of much Damage.

Vitruvius tells us, the first Men built their Houses with flat Roofs, but finding that these did not defend them from the Weather, they (being constrain'd by Necessity) begun to make them ridg'd; that is to say, rais'd in the middle.

These Roofs are to be rais'd to a higher or lower Pitch, according to the Country in which they are.

For which Reason in *Germany*, they raise their Roofs

to a very great Pitch, by Reason of the great Quantity of Snow that falls there.

They cover their Roof with *Shingles*, (*i. e.* small Pieces of Wood, or with thin Slates or Tiles; for if they would raise them otherwise, they would be ruin'd, by Reason of the Weight of the Snow.

But we who dwell in a more temperate Climate, ought to chuse such a Pitch as may secure the Building, and be of handsome Form.

Therefore we commonly divide the Breadth of the Roof into four equal Parts, and take three of them for the Roof, which according to some makes the most agreeable Pitch for our Country, and is the Foundation for raising any Manner of Roof, whether Square or Bevel.

As to Roofs, says a modern Author, there is a Plate to go round a Building, which either may or may not be accounted a Part of the Roof, it may be esteemed as the Foundation or Tye of the Walls, or it may be taken as only that on which the Roof lies.

These Plates are to be Dove-tail'd at the Angles, and tenented together at their Length, which is what the Workmen call cogging down to the Plate which prevents its flying out from the Foot of the Angles of a Building; Pieces Dove-tail'd cross the Angles of the Plate, serve to keep it from spreading, and is the Foot of the Hip.

There are various Sorts of Roofs,

Roofs, and various Ways of framing them, and different Heights for Buildings of the same Breadth, according to the different Sentiments of Surveyors or Carpenters. And a good Roof is the most difficult and most useful Part of Carpenters Work.

The common Pitch of Roofs is to have the Rafter Length, if it spann'd the Building at once, to be three fourths of the Breadth of the Building.

Some make them flatter, as a Pediment Pitch, and the old *Gothick* Way, was to make them the whole Breadth; but some Authors take the middle Path between both Extremes of three fourths of the Breadth of the Building, and Pediment Pitch, making the Pitch or Perpendicular Height to be two sevenths of the Breadth of the Building, within Side; and the Length of the Rafter four sevenths, being of the Breadth of the Building, or twice the Perpendicular Height of the King Post.

Indeed *Palladio* says, the Breadth of the Place to be roofed, must be divided into nine Parts, two of which shall be the Pitch; for, says he, if the Roof were made one fourth of the Breadth, it would be too steep.

But it is to be observ'd, that *Palladio* speaks of *Italy*, or of Southern Climates, for he says in *Germany* where the Snow falls in great Quantities, the Roofs are made very sharp, and are cover'd with Shingles, &c. for otherwise the Weight of the Snow would crush them.

The Height of the Pitch of a Pediment, is one fourth of the Breadth of a Building, which is esteemed in *England* rather too flat, especially for Tilcing: therefore some make Use neither of that Proportion, nor of the third of the Breadth of the common Pitch, and use a Medium Proportion between the two Extremes, &c.

Example. Suppose a Building to be ten Foot broad Work, according to the following Table.

If the Breadth of the Building be	Feet.	The Pediment Pitch $\frac{1}{4}$ perpendicular Height	Feet. Inches.	The common one, $\frac{1}{3}$ perpendicular Height	Feet. Inches.	The Medium $\frac{2}{3}$ perpendicular Heights.	Feet. Inches.
10			2 6		3 4		2 10 $\frac{1}{2}$
12			3 0		4 0		3 6
14			3 6		4 8		4 0
16			4 0		5 4		4 6 $\frac{1}{2}$
18			4 6		6 0		5 2
20			5 0		6 8		5 8 $\frac{1}{2}$
22			5 6		7 4		6 3 $\frac{1}{2}$
24			6 0		8 0		6 10 $\frac{1}{4}$
26			6 6		8 8		7 5
28			7 0		9 4		8 0
30			7 6		10 0		8 7
32			8 0		10 8		9 2
34			8 6		11 4		9 8
36			9 0		12 0		10 4 $\frac{1}{2}$
38			9 6		12 8		13 10 $\frac{1}{2}$
40			10 0		13 4		11 5

The Use of the Table is, if the Span or Breadth of a Building is 26 Feet, the Perpendicular Height of a Roof, Pediment Pitch is six Feet, six Inches; if the common Pitch, eight Feet, eight Inches, the Medium of which is made to be seven Feet, 5 Inches, for the following Reasons.

The common Pitch, is not only unpleasing to the Eye, but is attended with this Inconvenience, if there be a Gutter round the Building, the Steepness of the Roof occasions Rain to come with so sudden a Velocity and Force into the Pipes, which are to convey the Water from the Gutters, that it fills the Gutters, and sometimes to that Degree, that the Water runs under the Covering of the Roof, and very much endamages the Timber, &c. of the Building, and the steeper the Roof is, the longer the Rafters, and the greater Quantity of Timber must be us'd in the Roof, as well as the more Weight from the greater Quantity of Timber, and the weakening the principal Timbers by adding more to its own Weight.

And the Pediment Pitch is inconvenient in lying too flat for these Climates so frequently subject to Rain and heavy Snows, which last would vastly press and incommode a Building, and would lie much longer on the Roof; its Declivity being so small; besides in strong Winds, attended with Rain, the Rain would drive under the Covering of Tiles or Slates, &c. and cause great Decay of the Timber.

In Order to avoid these inconveniencies, the Medium between the two Extremes may be taken, according to the following Tables, in which some are made stronger than others; that the Method may be made Use of, as Necessity requires, and Time is allow'd to perform it in.

Take the following Rule for the Proportion of Beams, whose Bearing varieth.

If the Beam bear in the Clear	Feet.	The Scantling must be	Inches. Inches.	
	12		6	and 8
	16		$6\frac{1}{4}$	and $8\frac{1}{2}$
	20		$6\frac{1}{2}$	and 9
	24		7	and $9\frac{1}{2}$
	28		$7\frac{1}{2}$	and $9\frac{1}{2}$
	32		8	and 10
	36		$8\frac{1}{2}$	and $10\frac{1}{2}$
	40		$8\frac{1}{2}$	and 11
	44		9	and 12

Of Roofs in General, observe the following Examples.

Fig. 1. is an Hexagon Plan, and an *o* g Rafter.

First, Draw the Plan *a b c d e f*, also the Line *b h*, then middle *a b* at *i*, and draw the Line *i h*; then will *b h* be the Base of the Hip, and *i h* the Base of the Rafter; from *b* draw a Line to *k*, perpendicular to *i h*, and equal in Length to the Perpendicular of the Rafter; also from *b* draw a Line to *g*, Perpendicular to *b h*, and equal to *b k*; then draw the Moulding Part of the Rafter *i k*, in what Form you think proper;

proper; so done, divide the Line *ib* any how, from which Divisions raise perpendicular Lines to touch the Curve Line *ik*; continue those Lines to touch the Line *bb*, as the dotted Lines in the Example shew, which will divide the Line *bb*, into the same Number of Parts and Proportion with the Line *ib*; then from those Divisions raise perpendicular Lines at Pleasure, and take the perpendicular Line 1 . 1 on the Line *ib*, to the Curve of the Rafter *ik*, in your Compasses, and set it up the correspondent perpendicular Line, on the Line *bb*, as 1 . 1, also the Line 2 . 2, and 3 . 3, and so of all the rest; and in each of those Points, stick a Nail, and bend a thin Lath round them, to touch them all at once; then on the Edge of it, draw the Curve of the Hip *gb*, which was to be done.

Fig. 2, represents the Hip *bg*, in Fig. 1. and 1 2 3 4 at the Point *e*, represents the Sole of the Foot of the Hip, before the Back is work'd.

First, Draw Lines on the Hip, at any convenient Distance, parallel to the Foot or Base *ac*, Fig. 2. then draw the Sole of the Foot of the Hip, as 1 2 3 4 at the Point *e*, in Fig. 1, and take in your Compasses the Distance between the Point 1, to the Line *ef*; or from 2, to the Line *ed*; and set it from the Back of the Hip *ab*, on those parallel Lines

as you see mark'd by Dots on them; then strike a Nail into each of those Dots or Points, and bend a thin Lath, to touch them all at once, and on the Edge of it strike a Curve Line; then draw a middle Line, down the Back of the Hip, and between that Line and the Curves created by those Dots, hew off the superfluous Wood, which will make the true Back of the Hip, and so of all other Roofs, in what Form soever; but only observe if your Plan is bevel, as one End of Fig. 5, to set the Superfluity of the Sole of the Hip, at the Point *c*, which is from 3, to the Line *cb*; and from 4 to the Line *cd*, on their proper Sides of the Hip; because one Side will be wider than the other, which is the Case on the Back of all bevel Hips.

The Plan *abcdef*, in Fig. 3. is a Hexagon, the same as Fig. 1. and the Lines *bh*, *gh*, *hk* and *bi*, in the one is equal to *bb*, *ib*, *bg* and *bk*, in the other, so are the Soles of the Feet of the Hips 1 2 3 4, at the two Points *e*, and there is no other Difference than the Curves of the Rafter, and consequently needs no other Explanation; and so of the two Hips, Fig. 2. and Fig. 4. the two last Figures being laid down only for Variety Sake.

The Design of the Gable End or Roof B. Plate 2.

Let the whole Breadth of Gable End or Roof A A be 20 Foot; divide the same into
P four

four equal Parts, take three thereof for the Length of the principal Rafter A B, and placing that Perpendicular from the Point C to the Point D, begets the Length of the Sleeper A D which will be 18 Foot. And the Length of the Dormer's principal Rafter from A to E, when laid to its Pitch upon the Back of the Principals, will reach to the Level Line F B or Top of the principal Rafter; and this is a general Rule for all Breadths.

1. Summer or Beam.
2. King-Piece, Crown Post, or Joggle Piece.
3. Braces or Strutts.
4. Principal Rafters.
5. The Sleeper.
6. Purlin of the Dormer.
7. Principal Rafter of the Dormer.
8. Single Rafter of the Dormer, standing on the Sleeper and Purlin.
9. The Point of the Sleeper.
- 10, 11. The Thickness of the Wall and Lintels or Wall Plates.

Of flat Roofs. Plate 3.

Within a Chamber Beam and Rafters joggled in, whose Weight lieth not chiefly in the middle, and may be so made, that without hanging up the Beam, the Principals may discharge the Weight, and how Drips may be made to walk on.

A Draught of a Flat Roof with a Crown or King Post.

The Breadth of the House, Cantalivers, Cornices and Eaves,

the Length of the Raftings and Curvings, which ought to be $\frac{3}{4}$ of the Breadth House.

The Principal Rafters are to be cut with a Knee (as in the Design) that they may the better support themselves, and the Burthen over them; upon the Upright of the Wali, and also secure that Part from the dripping in of the Rain, which otherwise would happen if the Rafters were made plain and furred.

The Beam to the Roof or Girder to the Garret Floor, ought to project without the Work as far as the furring or shreading, which is the Projection of the *Cornice*.

1. Chamber Beam.
2. Principals joggled into the Chamber Beam.
3. The Place where the Principals are joggled in.
4. Puncheons or Braces.
5. Drips to walk on, and may be made with the less Current, that the Roof may be made the more Pitch, for the Strengthening thereof; and may be made higher or lower, according to the Building and Discretion of the Architect.
6. Battlements.

This Manner of framing the Roof will be useful, from 20 to 30 Foot, or thereabouts.

1. Ground Plate.
2. Girder or Binding, introduce or Bressummer.
3. Beam to the Roof, or Girder to the Garret Floor.
4. Principal Posts, and upright Brick-wall.
5. Braces.
6. Quarters.

7. Interduces.
8. Prick-Post or Window-Posts.
9. Jaumbs or Door Posts.
10. King-Piece or Joggle-Piece.
11. Struts.
12. Cellar-beam, Strut-beam, Wind-beam or Top-beam.
13. Door-hand.
14. Principal Rafters.
15. Furrings or Shreadings.
16. Ends of the Lintels and Pieces.
17. Bedding Moulding of the Cornice, over the Windows and Space between.
18. Knees of the Principal Rafters, which are to be of one Piece.
19. Purline.

ROOF. How to find the Length of the Sleepers to a Dormer Roof.

ac is the Width or Spand of the Roof, and ab and cb , is the Pitch of the Rafters; ig and kd , shews the Back of the Roof on which the Sleepers are to lie, and are equal to ab and cb , and iac is the Plate or Beam, on which the Rafters ab cb stand.

First, Draw the Gable End or Rafters ab and cb , and divide them in the middle at a c and e ; from whence raise a Perpendicular at Pleasure, towards f .

Then take the Length of the Rafter in your Compasses, and set it on the Perpendicular at e from e to f ; and draw fi and fd , which are the Length of the Sleepers sought for.

The Names of the Timbers.

I. Beams. II. Principal Rafters. III. Cellar Beams. IV. King Posts. V. Prick-Posts. VI. Struts. VII. Sleepers. VIII. Purlings. IX. Small Rafters.

ROOFING in ordinary Buildings is worth 7 or 8 *s. per Square*; but in great Buildings 10 or 11 *s. per Square*. See *Framing*.

Roofing is commonly measured by the Square, as Flooring.

ROSE [in *Architecture*, &c.] is an Ornament cut in the Resemblance of a Rose.

It is chiefly us'd in Friezes, Cornices, Vaults of Churches, and particularly in the middle of each Face of the *Corinthian* Abacus. And in the Spaces between the Modillions under the Plafonds of Cornices.

ROSE-NAILS. See *Nails*.

ROTATION [in *Geometry*] is the Circumvolution of a Surface, round an immoveable Line, call'd the Axis of Rotation.

ROTATION [in *Mechanicks*] Rolling, or turning round.

ROTHER NAILS. See *Nails*.

ROUGH STONE. See *Rag-Stone*.

ROUGH CASTING. See *Plastering*.

ROUGH Mortar is us'd in many Places in *Kent*, &c. and is made with a Sort of Sand, which when it is mix'd with the *Lime*, makes it look as red as Blood, but with these they mix Powder of Cinders, which

changes it to a kind of blueish Colour, with this they rough cast their Houses.

ROUND HEADS. See *Nails*.

RUDENTURE [in *Architecture*] is the Figure of a Rope or Staff sometimes plain, sometimes cut carved, with which the third Part of the Flutings of Columns, are sometimes fill'd up.

There are also *Rudentures* in *Relievo*, laid on the naked of Pilasters, not Fluted, an Instance of which we have in the Church of St. *Sapienza*, at *Rome*.

RUDENTURES says M. *Le Clerc*, are cut, on some Occasions in the Flutings, to strengthen their Sides, and render them less liable to be broken.

For Instance, when Fluted Columns or Pilasters are made without Pedestals, and plac'd on a Level with the Ground; or at least so little rais'd, as to be without the reach of the Hand; their Flutings must be rudented or cabled (as they call it) as far as one third of their Height; that is, they must be fill'd up one third Part to that Height with these Rudentures, in Order to strengthen the Sides, which might otherwise be soon defac'd.

These Rudentures, which were at first invented for Use, says M. *Le Clerc*, have been since converted into Ornaments to enrich the Flutings, so that instead of plain substantial Rudentures, we now frequently see them exceedingly weak and slender, being wrought in Form

of twisted Ribbons, Foliages, Chaplets, and other rich and delicate Ornaments.

But this kind of Rudenture says he, should never be us'd except in Columns and Pilasters of Marble, and such as are beyond the reach of the Hands of the People.

One may likewise for the greater richness, as well as for the Sake of the greater Ease, make these Ornaments of Brass gilt, to be fitted within the Flutings.

These delicate Ornaments are also found to succeed very well in Columns and Pilasters of Wood; where they are cut with a great Deal of Ease and Justness.

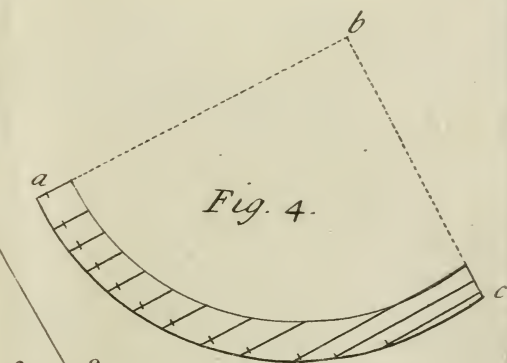
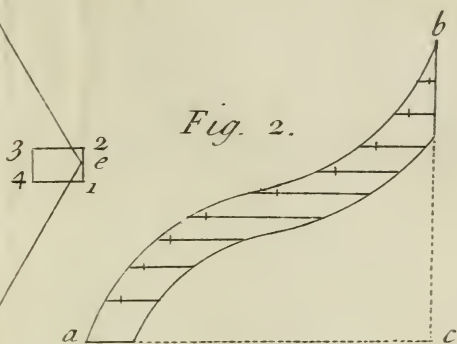
RUDERATION [in *Building*] is a Term us'd by *Vitruvius* for the laying of a Pavement with Pebbles.

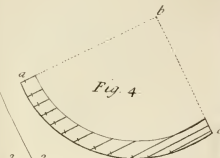
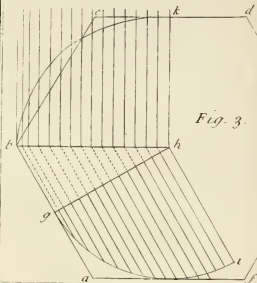
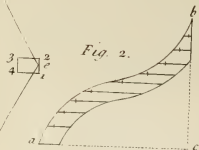
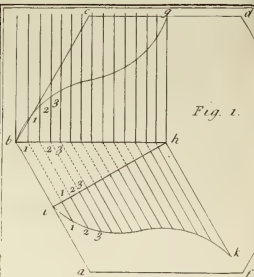
To perform the *Ruderation*, it is necessary that the Ground be well beaten to make it firm and to prevent it from cracking. Then a *Stratum* of little Stones are laid to be afterwards bound together with Mortar made of Lime and Sand.

If the Sand be new, its Proportion may be to the Lime as 3 to 1, if dug out of old Pavements or Walls, as 5 to 2.

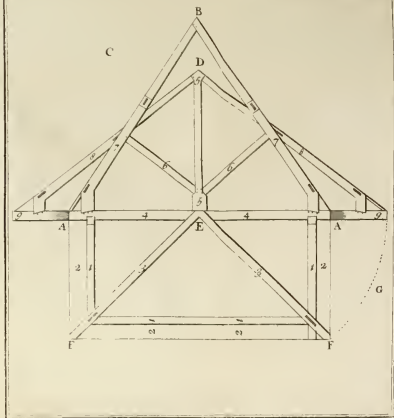
RUDERATION as *Daviler* observes, is us'd by *Vitruvius* for the courtest and most artless kind of Masonry, where a Wall is, as it were, cobbled up.

RULE, a simple Instrument, ordinarily of hard Wood, thin, narrow and strait, serving to draw Lines withal.









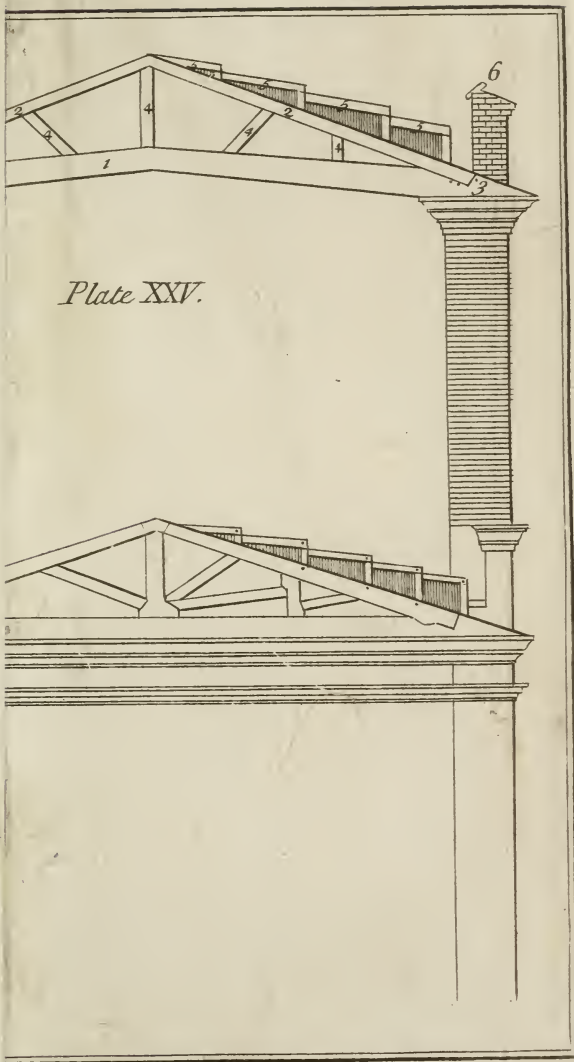
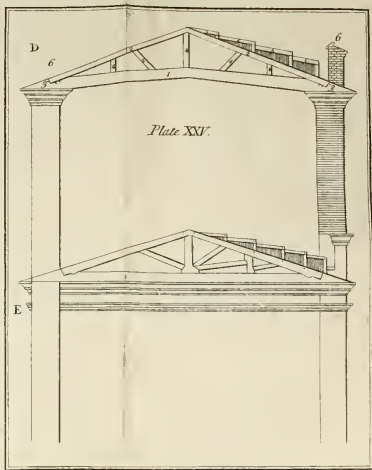
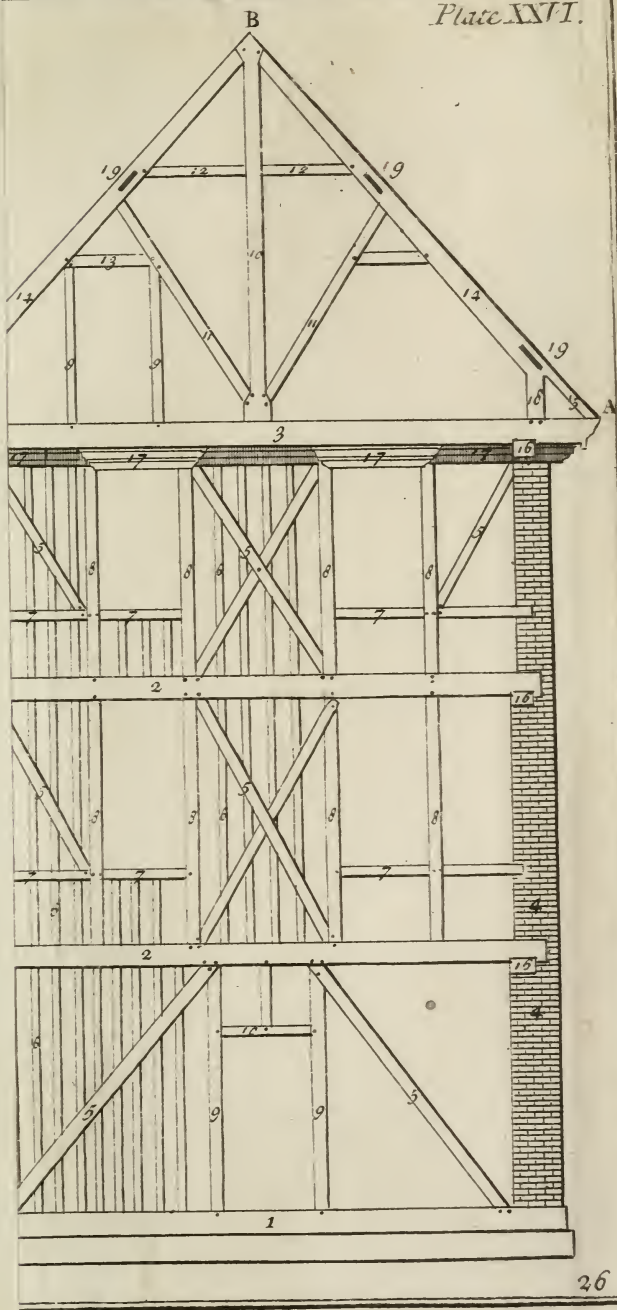
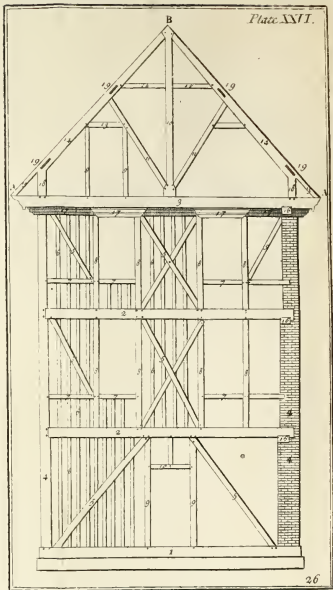


Plate XXV.







A Masons Rule is 12 or 15 Foot long, and is apply'd under the Level for regulating the Courfes, and for making the Piedroits equal.

A Stone-Cutters Rule is ordinarily four Foot long, and divided into Feet and Inches.

Carpenters Rule is an Instrument most commonly made of Box Wood, 24 Inches long and one and a half broad; each Inch being subdivided into 8 Parts. On the same Side with these Divisions, is usually *Gunter's Line* of Numbers.

On the other Side are the Lines of Timber and Board Measure, the first beginning at 82, and continued to 36, near the other End: The latter is numbred from 7 to 26 4 Inches from the other End.

The Use of Coggleshall's Sliding Rule in the Mensuration of Artificers Work.

This is generally plac'd upon one Side of one Leg of a two Foot Rule, consisting of four Lines.

Of which two Lines are plac'd on a Slip or sliding Part, and the other two upon the Leg of the Rule, and are thereby fix'd.

These last two Lines plac'd on the Rule, shall be hereafter in Practice call'd the *Stock*, and the two middle Lines, the *Slip*.

2. The uppermost Line on the Stock, and the two Lines on the Slip are all alike numbred, viz. from 1, 2, 3, &c. to 1 in

the middle, and from thence to 10 at the End, and the undermost Line from 4, 5, 6, &c. to 40, which is the Square Line, and when us'd in Timber, the Girt-line.

3. Take Notice also, that the Lines on the Slip, and that next above it, are each divided between 1 and 2 into 10 Parts, and each tenth is subdivided into 5 Parts, and consequently the whole Division contain'd between 1 and 2, is thereby divided into 50 Parts, and if each Division be suppos'd to be again subdivided or equal to 2; then the whole Space may be said to be divided into 100 Parts.

4. The Spaces between 2 and 3, and between 3 and 4 are each decimally divided into 10 Parts, as before; and as the Distance between 2 and 3 is less than between 1 and 2, therefore these tenths are each subdivided into two Parts, and consequently the whole Space between 2 and 3, will be divided but into 20 Parts; and if each Part be accounted to be divided into five lesser Parts, or each = 5, then the whole Space between 2 and 3, may be or suppos'd to be divided into 100 Parts, as before between 1 and 2.

5. The other Divisions between 4 and 5; 5 and 6; 6 and 7; 7 and 8; 8 and 9, being yet lesser and lesser, are therefore divided into 10 Parts only; wherefore accounting each Part equal to 10, then every of these Divisions may be suppos'd to be divided into

100 Parts, as the Preceeding.

6. The remaining Length from 1 in the middle, to 10 at the End, is divided respectively after the same Manner, as also are the respective Divisions of the Girt Line on the Stock, which are contain'd between the beginning of it at 4 to 10; but the Divisions from 10 to 40, are first each decimally divided into tenths, and each tenth subdivided into 4th Parts.

At the Girt Line, just at the Beginning before 4, there are two Divisions, each subdivided into four Parts; and at the End beyond 40, there are two, each subdivided into two Parts.

These two Divisions at the End of the Line beyond 40, each subdivided into two Parts, are the same as the first two Divisions divided into halves, that are next after 4 at the beginning of the Line, that is, if you suppose that from 40 the whole Line was immediately to begin again, placing 4 the Beginning in the Place of 40 at the End, then those two Divisions would represent the first two Divisions between 4 and 5.

Likewise the two Divisions sub-divided into four Parts, plac'd before 4 at the Beginning are equal to the two last Divisions, next before 40, at the End.

That is, supposing that the Space between 30 and 40 at the End of the Line was to be prefix'd before 4 in the beginning, then would the two last Divisions before 40, be in the

same Place of the two Divisions before 4.

To number or express Quantities, on this Rule observe

1. Let the Space between 1 at the beginning of the Line, and 1 in the middle, represent one Integer, as one Foot or one Inch, &c. then will 1 at the beginning, signify $\frac{1}{10}$ thereof; 2 will signify $\frac{2}{10}$; 3 will signify $\frac{3}{10}$, and so on; and lastly the 1 in the middle 1 Integer as aforesaid; and as before was shewn, that every such principal Division of 1, 2, 3, 4, 5, 6, 7, 8, 9; 1 was severally divided into 100 Parts, therefore this Integer is divided into 1000 Parts.

2. The following Divisions from 1 in the middle, as 2, 3, 4, 5, 6, 7, 8, 9, 10, are severally whole Integers; that is, when the Space from 1, in the beginning to 1 in the middle, is reckon'd the Integer, then the 2 following, signifies two Integers; the 3, signifies three Integers, &c. and so consequently the End of the Line, signifies ten Integers, and their respective sub-divisions; represent their fractional Parts, as has been before shewn in the first Integers.

3. But if 1 at the beginning of the Line be accounted an Integer or one, then the 2 following signify two Integers; the 3 following, three Integers, &c. and the 1 in the middle signifies 10 Integers.

Now as the two following, the 1 in the middle, did before repre-

represent 2, when the 1 in the middle represented one Integer, so now will the same 2 represent 20, when the 1 in the middle represents ten Integers, and consequently the following numbers, 3, 4, 5, &c. to 10, will represent so many hundred Integers to 1000; so in like Manner, if the Line be began with 100, then the 1 in the middle will represent 1000, and the 10 at the End, 10000, &c.

4. When the Line is begun with 1, and the middle one signifies 10, then every Decimal or tenth Division following between 1 and 2, between 2 and 3, &c. will represent an Integer.

Thus the first tenth Division after 1, in the middle signifies 11, the second tenth, 12; which is number'd 12 with a smaller Figure than the others, and sometimes only distinguish'd by four Points thus : : and in like Manner of all others, of which every fifth is distinguish'd by a longer Stroke than the others, as 15, 25, 35, &c. and the Subdivisions of each Integer, are fractional Parts thereof.

5. When the Line is begun with 10, then every tenth Division between 1 and 2, between 2 and 3, &c. does each represent an Integer (as has been said before of the tenths following the middle of the Line) thus the first tenth after 1 at the beginning, signifies 11, the second tenth, 12, the third tenth, 13, &c. (which has its Division longer than the others, as aforesaid) the sixth tenth, 16, &c.

The Uses of this Rule in Measuring.

1. To multiply one Number by another.

The Analogy is,

As 1 is to the Multiplier : : so is the Multiplicand to the Product.

Example 1. Multiply 7 by 9.

Practice. Begin the Line 1, and set 1 on the Slip, to 7 the upper Line of the Stock, and against 9 on the Slip, stands 63 on the upper Line of the Stock, which is the Product requir'd.

Example 2. Multiply 10 by 12.

Practice. Begin the Line with 10; set 1 on the Slip to 10 on the Stock, and against 12 on the Slip, stands 120 on the Stock, which is the Product requir'd, and so in like Manner any other Number given.

To perform Division by Rule.

The Analogy is,

As the Divisor is to 1. : : so is the Dividend to the Quotient requir'd.

Practice. Divide 72 by 9. begin the Line with 1, place the Divisor 9 on the Stock against 1 on the Slip, and against 72 on the Stock, stands 8 on the Slip, which is the Quotient required.

Example 2. Divide 630 by 15. Begin the Line with 10, then against the Divisor 15 on the upper Line of the Stock set 1 on the Slip, and against 630 on the Stock, stands 42 on the Slip, which is the Quotient requir'd.

The Rule of Three, by the Sliding Rule.

The Analogy is,

As the first given Number is to any other Number (as 5 is to 11, &c. so is the second given Number (as 10) to a fourth Number, which is the Number sought for in the same Proportion.

Example 1. If five Men are paid 11 Pounds for one Weeks Work, what must ten Men receive for the same Time, at the same Rate?

Practice. Begin the Line with 1, then set 5 on the Slip against 11 on the Stock, and against 10 on the Slip stands 22 on the Stock, which is the Answer of the Question.

Example 2. If the Diameter of a Circle be 7 Feet, whose Circumference is 22 Feet, what is the Circumference of another Circle, whose Diameter is 22 Feet?

Practice. Begin the Line with 1, then set 7 on the Slip, against 22 on the Stock, and against 21 on the Slip, stands 66, the Circumference requir'd.

Example 3. If 21 Bricks pave one Yard square, how many Bricks will pave 30 Yards.

The Analogy is as 1 is to 21, so is 30 to the Number requir'd.

Practice. Set 1 on the Slip to 21 on the Stock, and against 30 on the Slip, stands 630 the Answer of the Question.

Now in working of the Rule of Three direct, as in the preceding Examples, you see, that as the second Number is always greater than the first; the fourth Number will be always greater than the third; and *e contra*.

And in the Rule of Three Inverse, as in the following Example; if the second be less than the first, the fourth will be less than the third; and *e contra*.

Example 4. If the Circumference of a Circle be 44 Feet, what will the Diameter of another Circle be, whose Circumference is 66 Feet?

The Analogy is as 44 to 14 : : So is 66 to the Number requir'd.

Practice. Begin the Line with 1, and against 44 on the Stock, set 14 on the Slip, then against 66 on the Stock, stands 22 on the Slip, which is the Diameter required.

Now from these Examples, it is plain that the second and third Numbers are never taken on the same Line which is always to be remembered.

It is also to be observ'd.

If in placing the first Number to the second, the third falls beyond the Line, take the third Number in the first Part, or the other Length of the Line, as if it was continued; giving it its Value, according to its Place, as before shown.

Of the Extraction of the Square Root.

By the Help of the lowermost Line on the Stock, before call'd the *Square Line* or *Girt Line*, the Square Root of any Number not exceeding 10000,

may be very readily found, as follows.

Practice. Begin the lowermost Slip of the Line with 10, and set 16 thereof to 4, the beginning of the *Square Line*, then the Numbers of the *Square Line* will be the Square Roots of the Numbers contain'd in the lower Line of the Slip; or those Numbers in the Slip, will be the Squares of those of the *Girt Line* on the Stock.

Thus against 5 on the *Girt* or *Square Line*, stands 25 on the Slip, and against 6 on the *Girt*, stands 36 on the Slip: So in like Manner.

$$\text{against } \left\{ \begin{array}{c} 7 \\ 8 \\ 9 \\ 10 \\ 20 \\ 30 \end{array} \right\} \text{ stands } \left\{ \begin{array}{c} 49 \\ 64 \\ 81 \\ 100 \\ 400 \\ 900 \end{array} \right\} \text{ which are the } \left\{ \begin{array}{c} 7 \\ 8 \\ 9 \\ 10 \\ 20 \\ 30 \end{array} \right\} \text{ Square Numbers of}$$

Hence 'tis plain that any given Square Number, under 1000 being found in the lower Line of the *Slip*, its *Square Root* or Side of its Square is that Number in the *Square* or *Girt-Line*, which is opposite to it.

2. Remove the Slip, and place its beginning 1 to 10 on the *Square* or *Girt-Line*, and accounting 1 the beginning of the Slip, as 100, then 40 on the *Square* or *Girt Line* stand against 1600 its Square in the *Slip*, and thus you have the Root of any Square Number under 1600.

3. Remove the Slip to its first Station, placing 16 on the Slip (beginning the Line with 10) against 4 the beginning of the *Square Line*; and then reckoning the said 16 in the Slip to be 1600, and the 4 in the *Girt-Line* against it to be 40; as when those Numbers were together at the other End in their last Station; then will the Square Numbers in the Slip go on from 1600 to 10000, whose Roots are contain'd in the *Square Line* opposite thereto: thus

Thus

Thus the Square Root of	{	1600	}	is	{	40	}	as exhibited by the opposite Divisions in the <i>Square</i> or <i>Girt-Line</i> .
		2500				50		
		3600				60		
		4900				70		
		6400				80		
		8100				90		
		10000				100		
		40000				200		
		90000				300 &c.		

And removing the Slip as at the second Operation, you may continue the square Numbers to 160000; and then altering the Slip as at the third Operation, you may continue them from 160000 to 1000000, and so on in like Manner *ad infinitum*.

To measure the Dimensions of Mason's Work by the Sliding Rule.

The Analogy for Foot Measure is as follows.

As 12 on the upper Line on the Stock, which in Foot Measure is always fix'd, and therefore noted with small Figures, (as has been before noted) is to the Dimensions Length in Feet and Parts of Feet accounted on the Slip.

So is the Breadth in Inches accounted on the upper Line of the Stock.

To its Content in Feet on the Slip.

Example. A Piece of Marble Pavement is 36 Foot and half in Length, and 33 in Breadth, what is the Superficial Content?

Practice. Set the Length 36 Feet and a half on the Slip to 1, the upper Line of the Stock, and against 33 on the Stock, shall stand 100, $\frac{1}{3}$ the Content requir'd.

And here it is to be observ'd, that when Fractions happen, as in this Example, they ought to be estimated as near to the Truth as can be, which in Practice of Business is near enough for our Purpose.

But to determine the true Quantity or Value of Fractional Quantities (it being impossible to be done by this Rule) you must have recourse to Vulgar or Decimal Arithmetick.

Example 2. In a Portland Slab 8 Feet 3 Inches long, and $17\frac{1}{2}$ Inches broad, how many Feet does it contain?

Practice. Set the Length 8 Feet 3 Inches on the Slip (which is 8 and $2\frac{1}{2}$ of the Subdivision of the Tenths) to 12 on the upper Line of the Stock, and against $17\frac{1}{2}$ on the Stock stands 12 and a very little more, which is equal to $4\frac{1}{2}$ square Inches, the true Content required.

And so in the like manner any other Quantities, as given.

The

The next in Order is solid Measure; which Business generally happens under the Forms of the Cylinder, the Cube, and the Parallelopipedon.

Of the *Cylinder*, the Analogy is as follows.

As the Length in Feet and Inches accounted in the lower Line of the Slip,

Is to 10, 635. accounted on the *Girt Line*;

So is $\frac{1}{4}$ of the Circumference or Girt in Inches,

To the solid Content in Feet required.

Example. In a Cylinder of Stone, 28 feet 9 inches long, and 15 Inches $\frac{1}{4}$ of its Girt or Circumference; what Number of solid Feet does it contain?

Practice. Set the Length 28 feet $\frac{3}{4}$ in the *Slip* to 10.635 in the *Girt Line*, and against 15 the Quarter of the Cylinder's Girt, accounted on the *Girt Line*, stands 61 on the *Slip*, which is the solid Content required.

Of the *Cube*, the Analogy is as follows.

As the Length or Side of the Cube in Feet and Inches accounted in the lower Line of the *Slip*,

Is to 12 accounted on the *Girt Line*,

So is the Depth or Side of the *Cube* in Inches, accounted in the *Girt Line*, to the solid Content in feet accounted on the *Slip*.

Example. There is a *Cube* of Stone, whose Side is $2\frac{1}{2}$ feet; what is the solid Content of it?

Practice. Set the Side of the *Cube* $2\frac{1}{2}$ feet, accounted on the *Slip*, to 12 on the *Girt Line*, and against 30 the Side of the *Cube* in Inches (which is equal to $\frac{1}{4}$ of its Girt) stands $15\frac{1}{2}$.

Of the *Parallelopipedon* the Analogy is the same as before of the *Cube*.

As the Length of the *Parallelopipedon* taken in feet and inches, accounted on the lower Line of the *Slip*,

Is to 12, accounted on the *Girt Line*,

So is half of the Girt of the *Parallelopipedon* in Inches accounted on the *Girt Line*, to the solid Content in Feet accounted on the *Slip*.

Example. There is a long *Cube* or *Parallelopipedon*, whose Length is 17 feet 9 inches and $\frac{1}{4}$ Part of the Girt accounted on the *Girt Line*, and against $22\frac{1}{2}$ inches the $\frac{1}{4}$ of the Girt accounted on the *Girt Line* stands 66 in the *Slip*, which is the solid Content requir'd.

But here it is to be remembered that, if the Base of the *Parallelopipedon* is not exactly square; having its Breadth greater or less than its Depth, then its Depth will, by taking $\frac{1}{4}$ of the Girt, not give the true Solidity.

But in such case you must find a mean Proportional between the Breadth and the Depth;

Depth: and this being done, you may then proceed as if the Breadth and Depth were equal.

A mean Proportional is a Number, which being squar'd or multiplied into it self, produces the same Quantity that two given Numbers would do, being multiply'd into one another, to which it is a mean Proportional; or otherwise it is the square Root of the Product produc'd by the Multiplication of the two unequal Sides into one another.

Suppose the Breadth of the Parallelopipedon be 9 inches, and the Depth 4 inches. I say, if the 9 be multiply'd by 4, the Product will be 36; and the mean Proportional between 4 and 9 is 6; for 6 times 6 is 36, which is equal to 4 times 9: Therefore 6 is the mean Proportional between 4 and 9.

Now suppose the Dimensions be as before, *viz.* 9 inches in Breadth, and 4 in Depth, and consequently is 26 inches in Girt; of which, if you take $\frac{1}{4}$ Part, *viz.* 6 $\frac{1}{2}$ for the Side of the Square, as in the Square Parallelopipedon, it is plain that it will produce a content too great for 6 $\frac{1}{2}$ multiply'd by 6 $\frac{1}{2}$ will produce 42 $\frac{1}{4}$, which is 6 $\frac{1}{2}$ too much in the Area, and that being multiply'd into the Length would carry on the Error much higher.

Hence it is evident, that to Measure an unequal Parallelopipedon, there must first be a mean Proportional found, which may be easier produced from the square Root of the Area of the Base, or as follows.

Set the greater of the 2 Numbers (as here 9) on the Square or *Girt-line* to the same Number 9 on the *Slip*, against the less Number 4 accounted on the *Slip*, stands the mean Proportional (6) on the square Line.

Or thus,

Set the less Number (4) on the same Number (4) on the square Line, and against the greater Number (9) accounted on the *Slip*, stands the mean Proportional (6) on the square Line as before.

The Mensuration of *Bricklayers Work* by this Rule.

Bricklayers Work is measured by the Foot, Yard, Square, and Rod.

In Yard Measure, the first stated Number must be 9, and for Rod Measure 272, which in Foot Measure is but 12, and in Order to these Operations it will be necessary to have a little Brass Stud fix'd in the upper Line of the *Stock* and *Slip* at 9, and 272 and $\frac{1}{4}$, whereby those Centre-points (as Workmen call them) or first Numbers will be readily found.

In *Yard Measure* you must take Notice that the Dimensions are taken in Feet and Quarters of Feet.

The Analogy in *Yard Measure* is,

As the first Number 9 accounted on the upper Line of the *Stock*.

Is to the Breadth in Feet accounted on the *Slip*; so is the Length accounted on the *Stock*, to the superficial Content on the *Slip*.

Example 1. If a Cellar be pav'd with paving Bricks, the Length of which is 15 Feet $\frac{3}{4}$, and the Breadth 12 and $\frac{1}{4}$, what will be the superficial Content thereof?

Practice. Set the Breadth 12 Feet $\frac{1}{4}$ on the *Slip* to the fixt Number 9 on the *Stock*, and against 15 Foot $\frac{3}{4}$, accounted on the *Stock* stand 21 $\frac{1}{2}$ on the *Slip*, which is the superficial Content requir'd.

Example 2. If 30 Bricks pave 1 Yard, how many Yards will 630 Bricks pave?

The Analogy.

As the Bricks of one Yard accounted in the *Stock*.

Is to 1 accounted on the *Slip*.

So is the Number of Bricks given, accounted on the *Stock* to the Yards, which they will pave accounted on the *Slip*.

Practice. Set 30 on the *Stock* to 1 on the *Slip*, and against 630 on the *Stock* stands 21 on the *Slip*, which is the Number of Yards that 630 Bricks will pave.

Of Square Measure.

In this the Dimensions are taken in Feet and Quarters of Feet as in Yard Measure.

By square Measure is meant

a square Space, containing 100 square Feet, or it is a Geometrical Square, whose Side is equal to 10 Feet, and consequently the whole equal to 100 Feet.

By this Measure all Manner of Tileing and Slating is perform'd, as follows:

As the Breadth accounted on the *Stock*.

Is to 100 accounted on the *Slip*.

So is the Length accounted on the *Slip*, to the content accounted on the *Stock*.

Example. If a Roof be 70 Feet in Length, and 15 Feet in Depth from the Ridge to the Eaves, what is the Content of it.

Practice. Set the Breadth 15 accounted on the *Stock*, to 1 accounted on the *Slip*, and against the Length 70 on the *Slip*, stands 10 $\frac{1}{2}$ the Number of Squares therein contain'd, which is equal to 1050 square Feet.

This Product or Content is but $\frac{1}{2}$ the Quantity of Tileing if both Sides of the Roof are equal, therefore the 10 $\frac{1}{2}$ Squares being doubled, the Content of the whole will be found to be 21 Squares compleat.

And here it is to be noted, that as one Square is equal to 100 Feet.

Half a Square is equal to 50

A Quarter of a Square equal to 25

And half a Quarter of a Square equal to 12 $\frac{1}{2}$

Rod Measure.

Rod Measure is a square Measure consisting of $272 \frac{1}{2}$ square Feet, produced by the Squaring of a Rod in Length, viz. $16 \frac{1}{2}$ Feet multiply'd into itself its product is $272 \frac{1}{4}$, the odd $\frac{1}{4}$ is rejected, and the 272 Feet only is reckoned a square Rod.

By this Measure are measured all Manner of Walls and Chimneys, which, tho' of various thicknesses, yet they are all measured as superficial Measure, being reduced to the Standard thickness of one Brick and Half.

By this Analogy.

As the Length accounted on the Stock.

Is to 272 accounted on the Slip.

So is the Height accounted on the Slip to the Content on the Stock.

Or thus,

As the first Number 272 on the Slip.

Is to the Length accounted on the Stock.

So is the Height accounted on the Slip to the Content on the Stock.

Glazier's Work.

Glaziers Measure their Work by the Foot Square, and take their Dimensions in Feet and 100 Parts of a Foot, and therefore on the Edge of Sliding Rules, the Foot is generally divided into

100 equal Parts, numbred, 10, 20, &c. to 100, and oftentimes the whole two Foot onwards from 100 to 200.

Sometimes Dimensions of Glass are taken in Inches and Quarters of Inches, tho' but rarely, which when they are so.

This is the Analogy.

As 144 which is the first and first Number for Foot Measure accounted on the Stock.

Is to the Breadth taken in Inches accounted on the Slip.

So is the Length accounted in Inches on the Stock to the Content on the Slip required.

Example. A Pane of Glass 31 Inches a half in Length and $8 \frac{1}{2}$ Inches in Breadth, what is the Content?

Practice. Set the Breadth $8 \frac{1}{2}$ in the Slip to 144 in the Stock, and against 31 Inches $\frac{1}{2}$ the Length stands 1. 85 in the Slip, which is the Content required.

The Use of the Carpenters joint Rule.

The Application of the Inches in Measuring Lengths, Breadths, &c. is obvious, that of Gunter's Line. See under the Line of NUMBERS.

The Breadth of any Surface as Board, Glass, &c. being given; to find how much in Length makes a square Foot.

Find the Number of Inches the

the Surface is broad in the Line of Board Measure, and right against it is the Number of Inches requir'd.

Thus if the Surface were eight Inches broad, 18 Inches will be found to make a Superficial Foot.

Or more readily thus apply the Rule to the Breadth of the Board or Glass; that Edge mark'd 36, being even with the Edge; the other Edge of the Surface will shew the Inches, and quarters of Inches, which go to a square Foot.

The Use of the Table at the End of the Board Measure.

If a Surface be one Inch broad, how many Inches long will make a Superficial Foot? Look in the upper Row of Figures for one Inch, and under it in the second Row is 12 Inches, the Answer to the Question.

The Use of the Line of Timber Measure.

This resembles the former, for it being known how much the Piece is square; look for that Number on the Line of Timber Measure; the Space thence to the End of the Rule is the Length, which at that Breadth, makes a Foot of Timber: thus if the Piece be nine Inches square, the Length that is requir'd to make a Solid Foot of Timber, is $21\frac{1}{2}$ Inches.

If the Timber be small and under nine Inches square, seek the Square in the upper Rank

of the Table, and immediately under it are the Feet and Inches that make a solid Foot, thus if it be 7 Inches square, 2 Foot, 11 Inches, will be found to make a solid Foot.

If the Piece of Timber be not exactly square; but broader at one End than the other; the Method is to add the two together, and to take half the Sum for the Side of the Square.

For *Round Timber*, the Method is to girt it round with a String, and to allow the fourth Part for the Side of the Square. But this Method is erroneous, for by it there is lost above $\frac{1}{3}$ of the true Solidity.

RULE of THREE

RULE of PROPORTION } 3

commonly call'd the GOLDEN RULE is a Rule which teaches how to find a fourth Proportional Number to three others given.

RUSTICK [in *Architecture*] a Manner of Building in Imitation of Nature, rather than according to the Rules of Art, the Columns are encompass'd with frequent Cinctures.

RUSTICK WORK, is where the Stones, &c. of the Face, &c. of a Building instead of being smooth, are hatch'd or pick'd with the Point of a Hammer.

RUSTICK ORDER, is an Order with *Rustick* Quoins, *Rustick* Work, &c. *Felicien* says, 'tis properly where the several Parts of the Five Orders are not exactly observ'd, but this confounds *Rustick* with *Gothick*.

S.

SAGITTA [in *Architecture*] *i. e.* an Arrow, which the *Italians* call *Sactta*, is what we call the Key-Piece of an Arch.

SALON } [in *Architec-*
SALGOON } *ture*] is a very lofty spacious Hall, vaulted at Top, and sometimes comprehending two Stories or Ranges of Windows, as that at *Blenheim House*.

The *Saloon* is a grand Room in the middle of a Building, or at the Head of a Gallery, &c.

Its Faces or Sides ought all to have a Symmetry with each other; and as it usually takes up the Height of two Stories, its Ceiling, as *Daviler* observes, should be with a moderate Sweep.

The *Salon* is a State Room. These are much us'd in the Palaces in *Italy*, and from them we took the Mode.

Saloons are frequently built square, and sometimes octogonal, as at *Marli*, and sometimes in other Forms.

Embassadors and other great Visitants, are usually receiv'd in the State Room.

The Bottom of its Plafond ought to be arch'd, as is practised in some of the Palaces of *Italy*.

SAMEL or **SANDEL Bricks** See *Bricks*.

SAND, is a fine, hard, gravelly Earth of great Use in Building, and other Works.

There are three Sorts of Sand distinguish'd by the Places whence they are drawn,

viz. Pit-sand, River-sand, and Sea-sand.

Sand is us'd in Building, as one of the Ingredients in Mortar.

For this Use Pit-Sand is of all the best, and of Pit-Sand the whitest is always the worst.

Of *River-sand*, that found in the Falls of the Water is the best, because most purged.

Sea-Sand is the worst.

Pit-sand, as being fat and rough, is most us'd in Building Walls and Vaults.

River-sand, serves for *Rough Casting*.

All Sand is good in its kind, if when squeez'd and handled it crackles, and if being put on a white Paper, &c. it neither stains nor makes it foul.

That Sand is naught, which mixt with Water makes it dirty, and which has been long in the Air; for such will retain much Earth and rotten Humour. And for this Reason some Masons wash their Sand before they use it.

De Lorine observes, that the Sand of *Puzzuolo* is the best in the World, especially for maritime Building.

Some distinguish Sand into *Male* and *Female*. The *Male* Sand is of a deeper Colour than another Sort of Sand in the same Bank or Bed, call'd *Female* Sand.

Founders make Use of Fossil Sand. It is properly a yellow fat Earth, whereof they make their Moulds for the Casting of small Work, whence they call it *Casting in Sand*.

The Plumbers use Sand in moulding

Moulding several of their Works, particularly large Sheets.

To prepare this Sand for their Sheets, they wet it lightly, stir and work it with a thick, and then they beat and plane it.

Sand at *London* is commonly sold for 3 s. per Load, 36 Bushels to the Load.

In some Parts of *Suffex* and *Kent*, 'tis sold for 18 d. per Load, at 12 Bushels to the Load. In other Parts of *Suffex* 'tis sold at 2 s. 6 d. per Load, at 18 Bushels to the Load.

SASH-LIGHTS. See *Painting*.

SASH-FRAME. See *Painting*.

SAW, is an Instrument serving to cleave or divide into Pieces divers solid Matters, as Wood, Stone, Marble, &c.

The Workmen who make the greatest Use of the Saw are the Sawyers, Carpenters, Joiners, &c.

The best *Saws* are made of Steel, ground bright and smooth; those of Iron are only Hammer harden'd; and thence the first, besides their being stiffer, are likewise found smoother than the last.

You may know, whether or not they have been well hammer'd, by the stiff bending of the Blade; and if they have been well and evenly ground, by bending equally in a Bow.

The Edge in which the Teeth are, is always thicker than the Back, because the Back is to follow the Edge.

The Teeth are cut and sharpen'd by a Triangular File,

the Blade of the Saw being first fix'd in a Whetting Block.

After they have been fil'd, the Teeth are set, that is to be turned askew, or out of the Right-Line, that they may make the Kerf or Fissure the wider, that the Back may follow the better.

This they perform by putting an Instrument call'd a *Saw-Wrest*, between every other two Teeth, and giving it a little Wrench towards you, and the other a little from you.

The Teeth are always set ranker for coarse, cheap Stuff, than for hard and fine, because the ranker the Teeth are set, the more Stuff is lost in the Kerf, and if the Stuff be hard, the greater the Labour in sawing it.

But of all *Mechanicks* there are none have so many as the Joiners, nor so many different Kinds, as

The *Pit-saw*, a large two handed Saw, us'd to saw Timber in Pits. It is set rank for coarse Stuff, so as to make a Kerf or Fissure of almost a quarter of an Inch; but for finer Stuff, finer.

The *Whip-saw*, which is also two handed, us'd in sawing such large Pieces of Stuff as a Hand Saw will not easily perform.

The *Hand-saw* is made for a single Man's Use. Of these there are various Kinds, as the *Bow* or *Frame* Saw, furnish'd with Cheeks; by the twisted Cord and Tongue in the middle of it, the upper Ends are drawn close

close together, and the lower set further apart.

The *Tenant-saw*, which being very thin, has a Back to keep it from bending.

The *Compass-saw*, which is very small, and its Teeth usually not set; the Use of it is to cut a round, or any other Compass Kerf; for which Purpose, the End is made broad, and the Back thin, that it may have a Compass to turn it.

SAWING, the Application of the Saw in dividing of Timber, &c. into Boards.

There are Mills for sawing of Wood, carried both by Wind and Water, which perform it with much more Expedition and Ease, then is done by the Hand.

These Mills consist of parallel Saws, which rise and fall perpendicularly by the Means of one of the grand Principles of Motion.

These require but a very few Hands, *viz.* only to push along the Timber, which are either laid on Rollers, or suspended by Ropes, in Proportion as the *Sawing* advances.

These are frequently found abroad; and were lately begun to be introduc'd into *England*, but the Parliament thought fit to prohibit them, because they would spoil the Sawyers Trade and ruin a great many Families.

M. *Felibien* in his Principles of *Architecture*, makes mention of a Kind invented by one

Missien, Inspector of the Marble Quarries in the *Pyrenees*, by Means of which, Stones are fawn even in the Rock it self, out of which they are taken.

Some of these, he says, are 23 Foot long, made of Iron, without Teeth; but he does not describe either their Form or Application.

Sawyers most commonly work by the Hundred, that is, by the hundred Superficial Feet, for which they have various Prices, not only in different Places, but also for different Kinds of Timber, as will appear by the following Articles.

Oak; the sawing of *Oak* is in some Places 2 s. and 8 d. in others 3 s. in others 3 s. 6 d. the hundred.

Elm; the sawing of *Elm* is in some Places, 3 s. the hundred; commonly about the Price of *Oak*.

Ash and *Beach*. The sawing of *Ash* and *Beach* is generally worth 6 d. in the Hundred more than *Oak* or *Elm*. In some Places 'tis 3 s. in others 3 s. 6 d. in others 4 s. *per* Hundred.

By the Load. Sawyers sometimes work by the *Load*; *viz.* so much for cutting out a Load (or 50 Foot) of Timber; the Price of which is various, according what the Timber is cut to. But the common Price is 10 s. the Load for *Ship Planks*, of two Inches thick; and for Building

Timber	{	Large Size, 6 s. or 6 s. 6 d.	}	the Load.
		Large Size, 7 s.		
		Small Size, 7 s. 6 d. or 8 s.		

When

When *Sawyers* saw by the Load, they commonly agree for it as follows.

They have all their Sizes which they are to cut, set down; and they will cut none smaller, neither will they slab any, unless they are paid for it by Measure, over and above what they are to have by the Load.

They never cut any Thing less than Rafters, which are about four and five Inches, and which is generally the smallest Timber in a Frame, except Quarters and Window Stuff, which they generally cut by the Hundred.

If the Carpenter will have any Pieces clear'd by slabbing, after they have cut them off to their Size, they will also be paid by Measure for it.

They generally prick off their Sizes from the outward Edges, and what is left in the middle, they lay by till they can fit it to some other Size, when it is wanted.

A Carpenter has a great Deal of Labour in hewing off outside Pieces, when 'tis saw'd by the Load.

Sawing by the Load is commonly reckon'd good Work for the Sawyer; but it wastes a great Deal of Timber, it being hew'd away to Chucks.

The lowest Price in *Suffex* is 6 s. the Load, and if it be not cut in very large Scantlings, they will have 7 s. which is the common Price for sawing a good large siz'd Timber Frame. But if the Timber Frame be small and slight, they will have 7 and 6 d. or 8 s. per Load.

Of *Ship Planks*] are cut by the Load for about 10 s. at two Inches thickness.

If they are sawn by the hundred, they have 3 s. per Hundred, and 2 d. for *Petting* of every Log.

If they have nothing allow'd for *Petting*, then they reckon so many Carves as there are Pieces, which is one Carve more than there really is.

They commonly cut Planks from $1\frac{1}{2}$ Inch to 3 Inches thick; but they are never paid for breaking Work, till it comes to a two Foot Carf.

Of *Compass Work*] (as Mill Wheels, Furnace Wheels, Forge Wheels, Rafters for Compass Roofs, &c.) they have 2 d. per Foot.

Bevil Work] For sawing of Bevil Work (as Hips and Sleepers, &c. Posts, &c. in Bevil Frames; as also Posts or Punchins in Polygonal Turrets, &c. also Cant Rails) they work by the Hundred; but they always reckon a Carf and a half; that is, they reckon half as many more Feet of sawing as there is.

Furnace Bellores are cut by the Foot Lineal Measure, at 1 s. per Foot.

Forge Bellores are cut by the Foot Lineal Measure, at 4 d. or 6 d. per Foot.

Ground Guts are also cut by the Foot Lineal Measure, if small, at 1 d. per Foot; but if 15 Inches deep, at $1\frac{1}{2}$ d. if 18 Inches, at 2 d. per Foot.

The Measuring of Sawyers Work is generally done by the Foot Superficial Measure.

There is no Difficulty in taking the Dimensions, for they reckon the Depth of the Carf for the Breadth, and the Length for the Length.

The Breadth (or Depth) and Length of a Carf being taken and multiply'd together (by cross Multiplication) gives the Area or Superficial Content of the Carf.

Having found the Number of Feet in one Carf; multiply it by the Number of Carves of the same Depth and Length, and so you have the Area of them all.

Note 1. That when they have thus cast up their Work in Feet, they are paid for it by the Hundred [that is 100 Feet] at various Rates.

2. That if the Carf be but six Inches (or be less than six Inches) in Depth, they have a Custom of being paid for Carf and half (as they phrase it) that is for half so much more as it comes to by Measures.

The Reason they urge for this Custom is, their Trouble in often Linding and removing their Timbers.

3. *That for breaking Work* [that is cutting a Log through the middle] and *Slabbing* [that is cutting off the out-side Pieces] if the Carf be more than 12 or 13 Inches deep, they are paid by the Foot Lineal Measure, at various Prices, according to the different Depth of the Carf.

15		1 d.	
18		1½	
20		2	
22		2½	
24		3	
26		3½	
28		4	
30		4½	
32		5	
34		5½	
36		6	

Inches deep,

} per Foot.

That in some Places 'tis the Custom to allow the Sawyer but one Breaking Carf in a Log; but some Sawyers claim it as a Custom to have *Half Breaking Work*; as if they have four deep *Curves*, then they will have two Breaking Works, and the other two hundred Work.

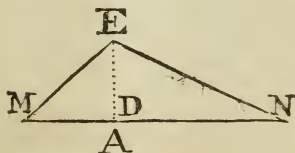
SCABELLUM [in the ancient *Architecture*] was a kind of Pedestal, usually made Square, sometimes Polygonal, very high and slender, commonly ending in a sort of Sheath or Scabbard, or profil'd in the Manner of a Balluster. The Use of it is to bear *Busto's Relievo's*, &c.

SCAF-

SCAFFOLD [in *Architecture*] is an Assemblage of Planks and Boards, sustained by Tressels and Pieces of Wood fixt in the Wall, upon which Masons, Bricklayers, &c. stand to work in building high Walls, &c. and Plasterers, &c. in Plastering Cielings, &c.

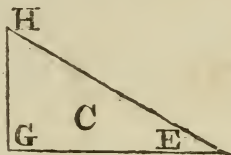
SCALE [in *Mathematicks*] signifies any Measures or Numbers which are commonly used; or the Degrees of any Arch of a Circle, or of such right Lines as are described; from thence, such as Sines, Tangents, Chords, Seconds, &c. drawn or plotted down upon a Ruler for ready Use and Practice in Geometrical and other Mathematical Operation.

A **SCALENE Triangle** } is
SCALENUM Triangle } a Triangle whose 3 Sides are unequal to one another, as the Triangles C and D.



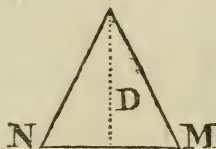
Here Note, that when one of the Angles of a Scalene Triangle is right angled, as the

Triangle C, right Angle at G, then such a Triangle is called a right angled plain Triangle,

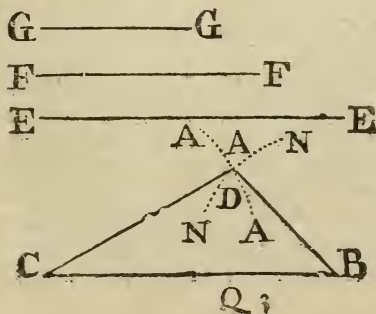


wherein the Side E G is called the Base; the Side H G, the Perpendicular, and the Side E H, the Hypotenuse.

Note also that in all Triangles, wherein a Line is drawn from any Angle to the opposite Side, and cuts the same at right Angles as the Line D, such a Line is call'd the Perpendicular of the Triangle, and the Side on which it falls, as N M, is called the Base.



To describe the **SCALENUM Triangle** A B C, whose Sides shall be equal to the 3 Lines given E E, F F, and G G.



First,

First, Make $BC = EE$, and on CB , with the Distance FF describe the Arch AA , and on B with the Distance FF , the Arch NN , intersecting AA in D .

Secondly, Join DB and DC , and the Triangle will be completed.

SCAMILLI *impares* [in the ancient *Architecture*] are certain Benches, Blocks or Zocco's, which serve to raise the rest of the Members of an Order, Column, Statue or the like, which was placed before the Horizon, *i. e.* beneath the Projectures of the *Stylobata Cordices* and other Saillies, and to prevent their being lost to the Eye, which may chance to be plac'd below their Level; or below the Projecture of some of the Ornaments of it.

SCANTLING [in *Carpentry*] is a Measure, Size or Standard, whereby the Dimensions, &c. of Things are to be determined.

SCAPUS [in *Architecture*] the Fust or Shaft of a Column.

SCENOGRAPHY is in Perspective a Representation of a Body on a Perspective Plane; or a Description thereof in all its Dimensions, such as it appears to the Eye.

The *Ichnography* of a Building, &c. represents the Plan or Ground Work of the Building; the *Orthography*, the Front or Upright of it; and the *Scenography*, the whole Building, the Front, Sides, and Height, and all.

SCHEME, is the Representation of any Geometrical Fi-

gure by Lines sensibly to the Eye.

SCHEME. See *Arches*.

SCIMA *reversa* is an OG , with the hollow Side downwards.

SCIMA. See *Cima*.

SCIOGRAPHY, the Profile or Section of a Building cut in Length and Breadth, to shew the Inside of it.

SCOTIA [in *Architecture*] is a Semi circular Cavity or Channel, between the *Tores* in the Bases of Columns; or between the *Thorus* and the *Astragal*, and sometimes 'tis put under the drip in the Cornice of the *Dorick* Order.

The *Scotia* has an Effect just opposite to that of the *Quarter* round.

Our Workmen frequently call it the *Casement*.

M. Perrault calls it a hollow obscure Moulding between the *Tores* of the Base of a Column.

It is also call'd by some the concave Member, and by others *Trochilus*, from the *Greek*, *Trochylos*, a Pulley, which it resembles as to Form.

In the *Corinthian* Base there are 2 *Scotia*, the upper of which is the Smaller. According to *Felibien*, the *Cavetto* is a fourth Part of the *Scotia*.

SCREW is one of the Mechanical Powers, consisting of a Cylinder sulcated, or hollowed in a spiral Manner, and moving or turning in a Box, or Nut cut so as to answer exactly, chiefly used in Pressing or Squeezing Bodies close; but sometimes also in raising Weights.

If the furrowed Surface be convex, the Screw is said to be *Male*;

Male ; if concave, 'tis *Female*.

Where Motion is to be generated, the *Male* and *Female* are always joined ; that is, whenever the Screw is to be used as a simple Engine or Mechanical Power.

When it is join'd with an Axis in Peritrochio, there is no Occasion for a *Female* ; but in that Case it becomes Part of a compound Engine.

In the Screw, the Power is to the Resistance, as the said Distance between 2 Threads to the Periphery of a Circle, run through by that Point of the Handle to which the Power is apply'd. Or,

SCREW, is a Cylinder cut into several concave Surfaces, continually inclin'd, or in plainer Terms, it is the wedge winded about the Convexity of a Cylinder, with a certain and equal Inclination, whose each Circumvolution is call'd a *Helix*, or Thread of the Screw, PO, NMLKH. See *Plate, Fig. 1.*

• This Engine is very useful for moving or pressing with great Force.

It was from the right angled Triangle, or inclin'd Plain, that the first hint was given to the Inventors of the *Screw*, which was made by the winding the said Triangle about the Convexity of a Cylinder, as the Triangle H K I, about the Cylinder H I P Q ; whereby it became of more Use, and was contain'd in less Space : for which End the Height of the Triangle has been allow'd for I K ; the Height of the Cylinder, and the Inclination of the

Hypothesis of the said Triangle has been given to the *Helix* or Thread H K, and so in like Manner to all the other *Helixes* that go upwards round about the Cylinder of the Screw, which in Fact makes the Thread or Helix an actual spiral Line, wound about the Convexity of the Cylinder.

Since that the Screw is no other than the wedge, it therefore follows, that if a Power sustain a Weight by means of a Screw, that Power will be to that weight as the height of the Screw is to the Head of the Screw.

That is, if the whole Line or Thread of the Screw was unwound from the Convexity of the Cylinder, and laid at full Length;

Then the Power apply'd.

Will be to the Weight that it will Equipoise.

As the Height of the Cylinder is to the Length of the extended Thread.

Whence it is easy to conclude, that in a Screw, the Force of the Power is the greater, the nearer the Circumvolutions of the Thread are together, and the more they are inclin'd to the Horizon ; because then the Height of the Cylinder is capable of containing a greater Length of the *Helix* or Thread, and consequently the *Helix* will have a greater Ratio to the Height of the Cylinder, whereby the Power will likewise have a greater Ratio to the Weight to be rais'd.

But to make an Estimate of the Force of the Screw, there is no Occasion to Measure the

whole Length of the Thread, nor the Height of the whole Cylinder; for if it be known how often the Height of one Thread from the other is contain'd in one Circumvolution or *Helix*, that is how often the Height H L is contain'd in the circuit of the *Helix* H K L, because H P, the whole Height of the Cylinder, is contain'd just as many times in the whole Thread of the Screw H K L M N O P, and therefore the Force is the same. See *Pl. f. 1.*

Hence 'tis plain that the Screw can raise a Weight by one *Helix* or Thread, no higher than from H to L, and that if the Height H L is contain'd ten times in the *Helix* H K L; a heavy Body will by Means of this Engine be sustain'd by a Power little more than equal to $\frac{1}{10}$ Part of its Weight.

This Engine is always work'd with a Lever of the second Kind (as the preceeding Figure) as A C, whose *Fulcrum* is the Centre of the Cylinder A : Distance of Weight = the Radius of the Cylinder and Power at C, &c. and as has been before prov'd, that the further the Power is applied from the *Fulcrum* of a Lever, the greater is its Force; so it is plain, that by increasing the Length of the *Lever*, the Force may be also increas'd at Pleasure; but then what is here gain'd in Force, will be lost in Space, as has been already prov'd in all the preceeding Engines. *f. 2.*

SCRIBING [*i. Joinery &c.*] is a Term us'd when one Side of a Piece of Stuff is to be fit-

ted to the Side of some other, which last is not regular: Therefore to make these two Pieces join close together all the Way, they *scribe* it thus; they lay the Piece of Stuff they intend to *scribe*, close against the other Piece of Stuff they intend to *scribe* to, and open their Compasses to the widest Distance, these two Pieces of Stuff bear off each other; then the Compasses (moving stiff in their Joint) they bear the Point of one of the Shanks against the Side they intend to *scribe* to, and with the Point of the other Shank they draw a Line on the Stuff they intend to be *scrib'd*.

Thus have they a Line on the irregular Piece, parallel to the Edge of the regular one; and if the Stuff be wrought away exactly to the Line when these Pieces are put together, they seem a Joint.

SCROWLS [*in Architecture*] See *Volute*.

SCULPTURE, is the Art of Cutting or Carving in Wood, Stone or other Matter, to form various Figures for Representations: Sculpture in its Latitude, includes both the Art of working in *Creux*, properly call'd *Engraving*, and of working in *Relievo*, which is what in Strictness is call'd Sculpture.

It is also us'd to signify the fashioning of Wax, Earth, Plaister, &c. to serve as Models or Moulds, for the casting of Figures of Metals in.

SCUPPER Nails. See *Nails*.

SEASONING of TIMBER is the preparing of Timber for Use;

Use: the *Timber* being fell'd, &c. must be laid 'up very dry in an airy Place, yet out of the Wind or Sun; others say it ought to be free from the Extremities of the Sun, Wind and Rain; and that it may not cleave but dry equally, you may dawb it over with Cow Dung; let it not stand upright, but lie along one Piece upon another, interposing some short Blocks between them, to preserve them from a certain Mouldiness, which they usually contract while they sweat, and that often produces a kind of *Fungus*, especially if there are any sappy Parts remaining.

Some again keep their *Timber* as moist as can be, by submerging it in Water, to prevent its cleaving; and this is good in Fir and other Timber too, both for the better Stripping and Seasoning.

When the Boards therefore have lain a Fortnight in Water, they must be set upright in the Sun and Wind, so as it may freely pass through them, especially during the Summer Heats, which is the Time of finishing Buildings, and turn'd daily; and thus even new sawn Boards will floor much better than those of a many Years dry Seasoning.

But to prevent all possible Accidents, when Floors are laid, let the Joints be shot, fitted and tack'd down for the first Year, nailing them for good and all the next; whereby they will lie stanch close, and without shrinking in the least; as if they were all of one Piece.

Water Seasoning among *Wheelwrights*, is of special Regard: As for the Elm, tho' the Tree be fell'd never so green, for sudden Use, if plunged four or five times in Water, especially Salt, which is best, it obtains an admirable Seasoning, and may be immediately us'd.

Besides which Method, some again commend burying in the Earth; others, in Wheat; and there are also Seasonings of the Fire, as for the scorching and hardening of Piles, which are either to stand in Water, or the Earth: Sir *Hugh Plat* informs us, that the *Venerians* us'd to burn and scorch their *Timber* in a flaming Fire, continually turning it round with an Engine, till they have got upon it a hard, black, coaly, Crust, whereby the Wood is brought to such a hardness and dryness, that neither Earth nor Water can penetrate it.

Mr. *Evelyn* says he had seen Charcoal dug out of the Ground, amongst the Ruins of the ancient Buildings, which in all Probability had lain cover'd with Earth above 1500 Years.

As for *Posts*, and the like that stand in the Ground, the burning the outsides of the Ends that are to stand in the Ground to a Coal, is a great Preservative of them, and some have practis'd the burning the Ends of *Posts* for *Railing* and *Paleing*, with good Success.

It likewise appears by the Abstract of a Letter written by *David Vonderbeck*, a German Philosopher and Physician, at
Am-

Minden, to Dr. *Largelot*, in the Philosophical Transactions, that the same is practiced in *Germany*. The Words are as follows.

Hence also we slightly burn the Ends of Timber to be set in the Ground, that so by the Fusion made by the Fire, the volatile Salt, which by Accession of the Moisture of the Earth would easily be consum'd to the Corruption of the Timber, may catch and fix one another.

SECANT, is a Line drawn from the Centre of a Circle, cutting it and meeting with the Tangent without.

SECTION [in the *Mathematicks*] signifies the cutting of one Plane by another; or a Solid by a Plane.

SECTION of a Building [in *Architecture*] is understood of the Profile and Delineation of its Heights and Depths, rais'd on a Plane, as if the Fabrick were cut asunder to discover the Inside.

SELLS [in *Architecture*] are of two Kinds, *viz.* *Ground Sells* [which are the lowest Pieces of Timber in a Timber Building, on which the whole Superstructure is erected] and *Window Sells* (sometimes call'd *Window Soils*) which are the Bottom Pieces in a Window-Frame.

The *Price of putting in Ground Sells* in a House, is commonly rated at 3*d.* or 4*d.* a Foot, for Workmanship only.

SERPENTINE Line; the same with *Spiral*.

SESQUITERTIONAL

Proportional, is when any Number or Quantity contains another once and one third.

SETTING. See *Pitching*.

SETTING of Fronts. See *Fronts*.

SEWERS [in *Architecture*] are Shores, Conduits, or Conveyances for the Suillage and Filth of an House.

Sir *Henry Wootton* advises that Art imitate Nature in these ignoble Conveyances, and separate them from Sight (where there wants a running Water) into the most remote, lowest and thickest Part of the Foundation, with secret Vents passing up through the Walls to the wide Air, like Tunnels; which all the *Italian Architects* commend for the Discharge of Vapours, though elsewhere but little practised.

SEXANGLE [in *Geometry*] is a Figure consisting of six Angles.

SHADOW [in *Opticks*] is a Privation of Light, by the Interposition of an opaque Body; but as nothing is seen but by Light, a mere Shadow is invisible; therefore when we say we see a Shadow, 'tis partly that we see Bodies plac'd in the Shadow, and illuminated by Light, reflected from collateral Bodies; and partly that we see the Confines of Light.

If the opaque Body which projects the Shadow, be perpendicular to the Horizon, and the Place 'tis projected on be horizontal, the Shadow is call'd a *Right Shadow*: Such are the Shadows of Men, Trees, Buildings, &c.

If the Opake Body be plac'd parallel to the Horizon, the Shadow is call'd a *versed Shadow*, as the Arms of a Man stretch'd out.

Laws of the Projection of SHADOWS from Opake Bodies.

1. Every opake Body projects a *Shadow* in the same Direction with its Rays; that is, towards the Part opposite to the Light. Hence as either the Luminary or the Body changes Place, the Shadow likewise changes.

2. Every opake Body projects as many Shadows as there are Luminaries to enlighten it.

3. As the Light of the Luminary be more intense, the Shadow is the deeper. Hence the Intensity of the Shadow is measured by the Degrees of Light that Space is derived from.

4. If a luminous Sphere be equal to an opake one, it illumines; the Shadow this latter projects, will be a Cylinder; and of Consequence, will be propagated still equal to it self, to whatever Distance the Luminary is capable of acting: so that if it be cut in any Place, the Plane of the Section will be a Circle equal to the great Circle of the opake Sphere.

5. If the luminous Body be greater than the opake one, the Shadow will be conical. If therefore the Shadow be cut by a Plane parallel to the Base, the Plane of the Section will be a Circle, and that so much the less, as it is at a greater Distance from the Base.

6. If the luminous Sphere be less than the opake one, the Shadow will be a truncated Cone, and of Consequence it grows still wider and wider, and therefore if cut by a plane Parallel to the Section, that Plane will be a Circle so much the greater, as 'tis farther from the Base.

SHAFT [in *Architecture*] as the *Shaft of a Column*, is the Body of it, thus call'd from its straitness; but is more frequently call'd by Architects the Fust.

Shaft is also us'd for the Spire of a Church Steeple.

The *Shaft* of the *Tuscan Column*, says M. *Le Clerc*, always terminates at the Top with an Astragal, and at Bottom with a Fillet, which in this Place is call'd *Orla*.

The Shaft usually diminishes in Thickness towards the Top; and this Diminution commences from a third Part of its Height; that is to say, the Height of the Shaft being divided into three equal Parts, the first of them is equal or cylindrical, and the two others diminish imperceptibly to the Astragal, where the Diminution terminates.

Some give a little Swelling to their Columns; that is, they make the Shaft somewhat bigger towards the Top of the first third of its Height, than towards the Bottom; or rather they diminish the Bottom of the Shaft, and by this Means make the upper Part of the first Division appear to swell.

But this Diminution at the
Bot-

Bottom of the Shaft ought never to exceed one Minute or one Minute and a half at the utmost. The Truth is, there ought to be no Swelling at all in a Column, excepting where there is some particular Reason for it; as where the Orders are plac'd over one another.

Some very considerable Architects, on Occasion encompass the Shafts of their Columns with several Cinctures or Fillets imboss'd. But these Kind of *Rustick* Ornaments, says M. *Le Clerc*, are never to be imitated, excepting in the Gates of Citadels, or Prisons, in Order to render their Entrance more frightful and disagreeable.

This too must be observ'd, that if these *Rustick* Ornaments may be admitted any where, 'tis only in *Tuscan* Columns, or at most in *Doric*; and never in the other more delicate Orders, especially where they are fluted.

SHAKY } [with *Builders*]

SHAKEN } such Stuff as is crack'd either with the Heat of the Sun, or the Drought of the Wind.

SHARD NAIL. See *Nails*.

SHEATHING NAILS. See *Nails*.

SHEET LEAD. See *Lead*.

SHIDES } [in *Building*]

SHINGLES } are small Pieces of Wood or quarter'd oaken Boards, sawn to a certain Scantling, or more usually cleft to about an Inch thick at one End, and made like Wedges four or five Inches broad, and eight or nine Inches long.

They are us'd in Covering, more especially Churches and Steeples, instead of Tiles or Slates.

This Covering is dear, yet where Tiles are very scarce, and a light Covering requir'd, is preferable to Thatch, if made of good Oak, and cleft, not sawed, and then well season'd in Water and the Sun, they make a sure, light and durable Covering: The Building is first to be covered all over with Boards, and the Shingles nail'd thereon.

The *Price of Shingles* are sometimes 20 s. per Thousand, but these are bad Ware; if they are good, they are worth 30 s. per Thousand; and 40 s. a Thousand have at sometimes been given for Shingles to lay on Steeples; for those that lie on high, and hang so Perpendicularly, ought to be of the best Sort.

The common Price of cleaving and making of Shingles, is 10 s. per Thousand.

A Tun of Timber will make about 3000 Shingles.

Of *Laying on Shingles*] In Order for Covering with Shingles, the Building must be first covered with Boards, which being done, the Shingles are fastened to those Boards, with 4 d. 5 d. or 6 d. Nails, in every Course at a certain Gage, viz. at 3 $\frac{1}{2}$ Inches or 4 Inches from under one another; for they commonly make three Waters (as they phrase it) that is, they usually hang three Shingles in Height, in the Length of one; so that if the
Shingles

Shingles are 12 Inches long, they are laid at four Inches Gage.

In Breaking Joint they do not observe to make one Joint over the middle of another; but they sometimes break Joint an Inch, an Inch or a half, or two Inches, according to the Breadth of the Shingles, for they (especially if they are cleft) are not exactly of a Size.

As for the Price of laying on Shingles.] For laying them on Spire Steeples, where the Work is high and troublesome, they have usually 20 s. a Thousand, but for lower Work (as upon Houses and the like) they will both cleave, make and lay them on for the same Price, or if they only lay them on, they will do it for 10 s. per Thousand.

For dressing old Shingles, [that is for hewing them and cutting off the ragged lower Ends] they have about 6 s. per Thousand.

As to the *Number of Shingles* that will cover a Square, 81 Shingles of four Inches broad, and laid at four Inch Gage, will cover a Yard square, and consequently 900 will cover a Square (or 100 Superficial Feet) of Healing; but it is usual to allow 1000 to a Square, because the Shingles seldom hold out to be all four Inches square, and to a 1000 Shingles, they allow a 1000 Nails.

SHINGLING the Covering with Shingles.

SHINLOG. See *Bricks*.

SHIP-WRIGHT. How to draw a Ship-Wrights Arch, by

the Intersection of Right Lines.

First, Draw the Base Line A B, and erect the perpendicular Lines A C and B D, the Heights of which answer to the Rake of the Arch or Ceiling of the Cabin, and draw the Line C D, and divide it in the middle at E; then divide A C into any Number of equal Parts, and C E into the same Number of Parts; also B D into any Number of equal Parts, and D E into the same; then draw Right Lines into each correspondent Divisions which will create the Arch A E B, which was required. See *Plate, Fig. 3*.

SCHOFEEET. To draw the two different Edges of a twisted Schofeet.

The Figure 4 in the Plate, represents the inward and outward Edges of a twisted Schofeet of a Semi-Circular Window, whose Jaumbs splay more or less, and whose Crown lies level without splaying; the Arch C G D is the Edge next the Head of the Window, and the Arch A G B is the Edge next the Room: The Question is, to draw the inward Arch A G B, so that it shall diminish gradually from nothing at the Crown G, to the Splays of the Jaumbs, at the Springing A C and D B.

First, Draw the Base Line A B, equal to the Width of the Window and Splays of both Jaumbs, and divide it in the middle at H, then set on the Splays from A to C, and from B to D.

When you have done this, take

take H C or H D in your Compasses, and set one Foot in H, and with the other strike the Arch C G D.

Erect the dotted Lines C E D F, equal to H G, and perpendicular to A B, and draw the Line E F, also the Lines A E and B F, into any Number of equal Parts; also E G and G F, and draw Right Lines to their correspondent Divisions, and they will form the Arch A G B, which will splay gradually from nothing at G to A C and D B, which is the Question requir'd.

SHOP WINDOWS, these may be afforded to be done at the same Rate as batten'd Doors, besides the Iron Work, as Bolts, Staples, Hinges, Locks, Keys, Latches, Chains, &c.

SHREADINGS, the same as *Furrings*.

SILERY, the same as *Cilery*.

SIZE for Gilding both with Silver and Gold.

For Gold *Size*, take yellow Oaker and grind it on a Stone with Water, till it be very fine, and afterwards lay it on a Chalk Stone to dry; this is the common Way; or you may wash it, as is taught in the Article WASHING of Colours; for when 'tis wash'd, to be sure nothing but the purest of the Colour will be us'd, and besides it is done with less daubing.

When the Oaker has been thus prepar'd, grind it as you do other Oil Colours, only with fat drying Oil; but it is something more laborious Work, in that it must be ground very fine, even as Oil it self; for the

finer it is, the greater Lustre the Gold will carry that is laid on it.

Here *Note*, that you must give it such a Quantity of your fat Oil, that it may not be so weak as to run, when you have laid it on; nor so stiff that it may not work well; but of such a competent Body, that after it is laid on, it may settle itself smooth and glossy; which is a chief Property of *Size*.

Silver *Size* is made by grinding White Lead with fat drying Oil, some adding a very small Quantity of Verdigrease to make it bind.

SKEWBACK. See *Arches*.

SKIRTING BOARDS, the narrow Boards that are fitted round the under side of Wainscot, against the Floor.

SKREEN, an Instrument us'd by Labourers in sifting Earth for making Mortar.

SLABS, the outside sappy Planks or Boards that are sawn off from the Sides of a Timber Tree.

SLATE, a blue fossil Stone very soft when dug out of the Quarry, and therefore very easily cut or sawn into long thin Squares or Escallops, to serve instead of Tiles for the Covering of Houses. The Ancients were not acquainted with the Use of Slate, and instead of them cover'd their Houses with Shingles.

Besides blue Slate, we have in *England* a greyish Slate, which is also call'd *Horsham* Stone, because the greater Quantities of it, are found about *Horsham* in *Suffex*.

The

The *blue Slate* is a very light, beautiful and lasting Covering; but then it is pretty dear, because the Roof must be first boarded over, and the Slates hung on Tacks, and laid with finer Mortar than Tiles.

The *grey Slate* is chiefly us'd in covering Churches, Chapels, Chancels, &c.

The Covering with this Sort of Slate, is dearer than Tiles; because the Timber of the Roof must be very strong for them, it being almost double the Weight of Tiles.

Mr. *Coleprests* directs, that in Order to judge of the Goodness of Slate, to knock it against any hard Body, to make it yield a Sound; and says, if the Sound be good and clear, the Stone is firm and good; otherwise its crazy,

Another Way of proving the Goodness of Slate, is first to weigh it exactly, and then to lay it 6 or 8 Hours under Water, and then wipe it dry and weigh it again, and if it weighs more than it did before, 'tis a Sign that it is of that kind, that soaks in Water, and therefore will not last long without rotting the Timber or Lath.

There is also another Way of proving it, by placing a Slate half a Day perpendicularly in a Vessel of Water, so as to reach a considerable Height above the Level of it: And if the Slate be firm and close, it will not draw Water, that is the Water will not have ascended above half an Inch above the Level of that in the Vessel, nor that, perhaps any where

but at the Edges, the Texture of which might probably be loosened by hewing; but if the Stone be bad, it will have drawn Water to the very Top, be it as high as it will. There are Slates in several Places, which the most experienced *Slaters*, or Coverers conjecture to have continued several hundred Years, and are still as firm as if first put up.

The *Blue Slate* cut into long Squares, or Escallops, makes a very handsome Appearance, and is commonly used in covering of Summer or Banqueting Houses in Gardens; it being a very light and lasting Covering.

But if these Slates be rudely cut, and carelessly laid (in Respect of Form) it is then accounted a cheaper Covering than with Plain Tiles, especially in those Countries where the Country affords Plenty of them.

As to the *Price of Slating*, it is valued at about 5 *d.* the Yard Square, or by the Square of 10 Foot (that is 100 Foot) from 30 *s.* to 3 Pounds or more in some Places.

As to the *Price of pointing Slates*, Mr. *Wing* says it is worth about 1 *s.* or 13 *d.* per Square for hewing and making them fit for the Work.

As to the *Price of Slates*, Mr. *Wing* says they are worth at the Pit 12 or 14 *s.* per Thousand, which will nearly do 36 square Yards.

Of *Measuring Slating*. It is measured in some Places by the Rod of 18 Foot Square, which contains 324 superficial Feet, or 36 Yards. In

In the Measuring of this Sort of Work, where there are Gutters or Valleys, there is commonly an Allowance, which is to take the Length of the Roof, all along upon the Ridge which makes the Gutters double Measure, as much more as really it is; which is allow'd in some Places, but not in others; and so depends upon the Custom of the Place.

SLEDGE, a kind of Machine or Carriage, without Wheels, for the Conveyance of very weighty Things, as huge Stones, &c.

The *Dutch* have a Sort of Sledge upon which they can carry any Burthen by Land. It consists of a Plank a Foot and half Broad, and the Length of the Keel of a moderate Ship, raised a little behind and hollow in the Middle, so that the Sides go a little aslope, and are furnished with Holes to receive Pins; the Rest is quite even.

SLEEPER [in *Architecture*] is the oblique Rafter that lies in a Gutter. See *Hip*. N. 1.

SLIPPER, the same as *Plinth*.

SLUICE, a Vent or Drain for Water.

SLUICE, a Frame of Timber, Stone, or any other Matter serving to retain and raise the Water of a River, &c. and on Occasion to let it pass: As the Sluice of a Mill, which stops and collects the Water of a Rivulet, &c. to let it fall at Length in the greater Plenty upon the Mill-Wheel; such, are those used as Vents and

Drains to discharge Water off Land; and such are the Sluices in *Flanders*, &c. which serve to prevent the Water of the Sea from Overflowing the lower Lands, except when there is Occasion to drown them.

Sometimes there is a kind of Canal inclosed between 2 Gates or Sluices, in artificial Navigation, to save the Water, and render the Passage of Boats equally Easy and Safe upwards and downwards; as in the Sluices of *Briare* in *France*, which are a sort of massive Walls Built parallel to each other, at the Distance of 20 or 24 Feet, closed with strong Gates at each End, between which is a kind of Canal or Chamber considerably longer than broad, wherein a Vessel being inclosed, is let out at the first Gate, by which the Vessel is raised 15 or 16 Foot, and passed out of the Canal into another much higher.

By such Means a Boat is convey'd out of the *Louure* into the *Seyne*, tho' the Ground between them be rais'd above 150 Feet higher than either of those Rivers.

SMALT, is a lovely Blue, if it lie at a Distance, but it must be only strew'd on upon a Ground of white Lead, for it so Sandy that it carries no good Body in Oil; and besides Oil changes the Colour of it, and make it look quite Black, except Whites be mix'd with it, and they spoil the Beauty of the Colour, and make it faint; therefore the best Way to lay it on, is by *Strewing*, and then there is not a more glorious Colour in the World.

The

The Manner of strewing Smalt.

First, Temper up white Lead pretty stiff, with good clear drying Oil; let it be as stiff as it well can be to spend well from the Pencil; cover over the Superficies of the Work that you intend to strew Smalt upon with this white Colour, and if it be the Margin of a Dial, whose Figures are already gilt with Gold, let every Part between the Figures, and where there is no Gold laid on, be done over, and be very exact in the Work; for the Smalt takes nowhere but on this new and moist Ground.

Lay the Work that is to be done over with strew'd Smalt flat, and strew it thin on the Thing to be coloured, and stroke over it with the Feather edge of a Goose Quill, that it may lie even and alike thick in all Places: when this has been done, dab it down close with a bunch of soft pliable Linen-cloth, that it may take well upon the Ground to be thoroughly dry; then wipe off the loose Colour with a Feather, and blow the Remainder of it off with a pair of Bellows, and the Work is finish'd.

This is the Method for Colouring any kind of Work with Smalt by strewing, provided the Work be such as requires only the plain Colour.

But in Case you are to Paint any kind of Body with Smalt, which requires Shadow for the more perfect Resemblance; as suppose it to be a blue Bell or a blue Boar, &c. in this Case, when you have drawn out the

perfect Symmetry of the Shape you intend, and have covered it with a Ground of white Lead, well and stiffly tempered with clear and fat Linseed Oil, then give it the necessary Shadows with good black well tempered; and when you have finish'd these Shadows, afterwards strew on the *Smalt* as before directed; and when the whole is dry, and the superfluous Part be taken away, the Work will appear with all its Shadows, as exact as possible.

Note, That the Work upon which you lay on this Ground, that is to be strew'd with Smalt, ought to be first sufficiently prim'd, and laid also over once with White, before the Ground is laid on, that you may be sure that the Ground is perfectly White; for a white Ground is the only thing that gives the Beauty and Glory to the Colour of the Smalt.

In all other Cases where the Work to be strew'd over with Smalt does not lie flat, you must take your Smalt upon a flat Bunch of Linnen-cloth, and so dab it upon the Ground you are to lay it upon.

Note, That there are 2 Sorts of Smalt, the one much finer than the other; but the coarsest gives the most glorious Colour of all, if look't on at a Distance; for near the Eye the Beauty is not so great; the finest is that which is call'd *Oil Smalt*, which is ground with white Lead, and may be laid in Oil; but does not bear a good Body, nor does it work but with much Difficulty.

SMITHS *Work* [in Relation to *Architecture*] is of divers Kinds, as making Casements, Pallisade Work in Gates or otherwise, Dogs, Bars, large Hooks, Hinges, Staples, &c. for which they have in some Places $5\frac{1}{2}d$, in others 4 *d. per Pound*; but for small and neat Hooks, Hinges, Staples, &c. they have from 4*d* to 8*d per Pound*. For Iron Balconies, 5*d per Pound*.

Of making a *Smith's Bill*. This should be done after the following Manner.

Mr. *Thomas Anderson*, his Bill of Materials had of, and Work done by *John Smith*; 1733.

	<i>l.</i>	<i>s.</i>	<i>d.</i>
<i>Jan.</i> 16. For 4 large Casements, weighing 40 <i>l.</i> } at 6 <i>d. per l.</i> - - - - - }	1	00	00
<i>Feb.</i> 6. For 5 small Casements, weighing 30 <i>l.</i> } at 6 <i>d. per l.</i> - - - - - }	0	15	00
-----12. For 12 Pair of Hooks and Riders for Doors, weighing 65 <i>l.</i> at 4 <i>d. per l.</i> - - }	1	01	08
<i>March</i> 17. For three great Bars for Chimneys, weighing 60 <i>l.</i> at 4 <i>d. per l.</i> - - - - - }	1	00	00
<i>April</i> 14. For 4 Door Bars, weighing 40 <i>l.</i> , at 4 <i>d. per l.</i> - - - - - }	0	13	04
-----25. For 4 Dogs, weighing 24 <i>l.</i> at 4 <i>d. per l.</i> -	0	08	00
<i>May</i> 12. For 4 large Bolts, for Doors, weigh- ing 6 <i>l.</i> at 4 <i>d. per l.</i> - - - - - }	0	02	00
	5	00	00

SOCLE } [in *Architecture*]
ZOCLE } a flat square Mem-
ber under the Bases of Pedes-
tals of Statues, Vases, &c. which
it serves as a Foot or Stand.

SOFFIT } [in *Architec-*
SOFFITO } *ture*] is any
Plafond or Ceiling form'd of
cross Beams or flying Cornices,
the square Compartments or
Pannels of which are enriched
with Sculpture, Painting or
Gilding. As those are which
are to be seen in the Palaces of
Italy, in the Apartments of *Lux-*
embourg at *Paris*, &c.

The Soffites of Arches, says
a modern Author, if they are
divided into Pannels, they must

be of an uneven Number, by
having a Pannel in the Middle.
The Border must be no more
than one Sixth, nor less than
one Seventh of the whole Breadth.

SOFFIT } is particularly
SOFFITO } used for the
under Side or Face of an Ar-
chitrave; and for that of the
Corona or *Larmier*, which we
call Plafond, and the ancient
Roman Architects, *Lacunar*.

It is enrich'd with Compart-
ments of Rosets; and has 18
Drops in the *Dorick* Order,
disposed in 3 Ranks, 6 in each,
placed to the Right Hand of the
Guttæ, and at the Bottom of
the Triglyphs.

SOILS,

SOILS. See SELLS.

SOLDER } [in *Architec-*
SODDER } *ture*] is a me-
tallick or mineral Composition,
used in Soldering or Joining to-
gether other Metals.

Solders are made of Gold,
Silver, Tin, Copper, Glafs of
Tin and Lead; and it is to be
observed, that in the Composi-
tion, there must be some of the
Metal to be soldered.

There are several kinds of
Solder, but that which more
immediately relates to our pre-
sent Business, is Solder for Lead,
used by Plumbers.

This is made of two Pounds
of Lead to one of Tin: but
for *Glaziers* Use it may be
made something finer.

As to the Price. Solder is
sold from 8 *d.* to 10 *d.* a Pound,
according to its Fineness.

The Goodness of Solder is
tried by Melting it, and pour-
ing the Bigness of a Crown-
piece upon a Table; for if
good, there will arise little bright
shining Stars therein.

To know if Solder be fine e-
nough for *Glazier's* Use: Some
direct to take a Piece of it and
bend it to and fro near their
Ear; for if it be of a fit Tem-
per, it will crackle like Nits.

SOLID [in *Geometry*] is the
third Species of Magnitude,
having three Dimensions, *viz.*
Length, Breadth, and Thick-
ness, and is frequently used
in the same Sense with Body.

It may be conceiv'd to be
form'd by the direct Motion,
or Revolution of any Superfi-
cies, of what Nature or Figure
soever.

A Solid is terminated or
contain'd under one or more
Planes and Surfaces; as a Sur-
face is under one or more Lines.

Regular SOLIDS, are those
terminated by Regular and
equal Planes: under this Class
come the *Tetrahedron*, *Hexa-*
hedron or *Cube*, *Octahedron*,
Dodecahedron, *Icosihedron*.

Irregular SOLIDS are all
such as do not come under the
Definition of *Regular Solids*;
such are the *Sphere*, *Cylinder*,
Cone, *Parallelogram*, *Prism*,
Parallelopiped, &c.

SOLID *Angle*, is an Angle
made by the meeting of three
or more Planes, and those join-
ing in a Point, like the Point
of a Diamond well cut.

SOLID *Numbers*, are those
which arise from the Multipli-
cation of a Plane Number by
any other whatsoever, as 18 is
a Solid Number made by 6,
(which is Plane) multiply'd by
3; or of 9, multiply'd by 2.

SOLID *Problem* [in *Mathe-*
matics] is one which cannot be
Geometrically solv'd, but by
the Interfection of a Circle and
a Conick Section; or by the
Interfection of two other Co-
nic Sections besides the Circle.

SOLIDITY, is a Quality of
a natural Body, contrary to
Fluidity, and appears to consist
in the Parts of the Bodies
being interwoven and entangled
one with another, so that they
cannot diffuse themselves sever-
al Ways, as Fluid Bodies can.
Or it is the Quantity of Space
contain'd in a Solid Body;
call'd also the *Solid Content* and
the *Cube* thereof.

SOLIDITY [in *Architecture*] is apply'd both to the Consistence of the Ground, wherein the Foundation of a Building is laid, and to a Massive in Masonry of extraordinary Thickness, without any Cavity within.

SOLIVE [in *Carpentry*] signifies a Joist or Rafter, or Piece of Wood, either slit or saw'd, wherewith the Builders lay their Ceilings.

These are made of different Thicknesses, according as their Lengths require, and their Distances from each other, are usually equal to their Depths.

SOLUTION [in *Geometry*, &c.] is the answering of any Question, or the Resolution of any Problem.

SOMMERING. See *Arches*.

SPHERE [in *Geometry*] a Solid Body contain'd under one single Surface, and having a Point in the middle, call'd the Centre, whence all the Lines drawn to the Centre are equal.

The Sphere is suppos'd to be generated by the Revolution of a Semi-circle about its Diameter, which is also call'd the *Axis of the Sphere*; and the Extreme Points of the Axis, the *Poles of the Sphere*.

The Properties of the Sphere.

1. A Sphere is equal to a Pyramid, whose Base is equal to the Surface, and its Height to the Radius of the Sphere.

Hence a Sphere being esteem'd such a Pyramid, its Cube or Solid Content is found like that of a Pyramid.

2. A Sphere is, to a Cylinder, standing on an equal Basis, and of the same Height as 2 to 3. Hence also may the Cube or Content of the Sphere be found.

3. The Cube of the Diameter of a Sphere, is to the Solid Content of the Sphere, nearly as 300 to 157: and thus also may the Content of the Sphere be measured.

4. The Surface of a Sphere is Quadruple to that of a Circle describ'd with the Radius of a Sphere. For since a Sphere is equal to a Pyramid, whose Base is the Surface, and its Altitude the Radius of the Sphere: the Surface of the Sphere is had, by dividing its Solidity, by a third Part of its Semi-Diameter.

If now the Diameter of the Circle be 100, the Area will be 7850; consequently the Solidity 1570000, which divided by a third of the Semi Diameter 100, the Quotient will be the Surface of the Sphere, 31400; which is manifestly the Quadruple the Area of the Circle.

The Diameter of a SPHERE being given, to find its Surface and Solidity;

Find the Periphery of the Circle, describ'd by the Radius of the Sphere.

Multiply (this being found) into the Diameter; the Product is the Surface of the Sphere: Multiply the Surface by the sixth Part of the Diameter, and the Product will be the Solidity of the Sphere.

Thus supposing the Diameter of the Sphere, 56, the Periphery

riphery will be found 175; which multiply'd by the Diameter, the Product 9800 is the Surface of the Sphere, which multiply'd by one sixth Part of the Diameter, gives the Solidity 919057, or thus;

Find the Cube of the Diameter 175616: then to 300157, and the Cube found, find a fourth Proportional 919057, and this will be the Solidity of the Sphere.

Or thus,

1. Multiply the Axis or Diameter into the Circumference, and the Product will be the Superficial Content; which multiply by the sixth Part of the Axis, and the Product will be the Solidity.

2. Or thus, : as 21 is to 11; so is the Cube of the Axis to the Solid Content.

3. Or as 1. is to .5236, so is the Cube of the Axis to the Solid Content.

Example. Let A B C D be a Globe, whose Axis is 20 Inches, then the Circumference will be 62.832: then by the first Rule multiply the Circumference by the Axis, and the Product will be 1256.64, which is the Superficial Content in Inches: take a sixth Part thereof, which is 209.44 (because an exact sixth Part of 20 cannot

62.832

20

6)1256.640 the Superficial Content.

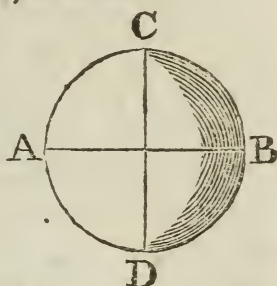
209.44 a sixth Part.

20

4188.80 the Solidity in Inches,

R 3

be taken) multiply that sixth Part by 20 (the Axis) and the Product will be 4188.8 the Solidity in Inches.



Or if you multiply the Superficial Content by the Axis, and take a sixth Part of the Product, the Answer will be the same.

Or thus by the second Rule.

The Cube of the Axis is 8000, which multiply'd by 11, the Product will be 88000, which being divided by 21, the Quotient will be 4190.47, the Solidity.

Or by the third Rule.

If the Cube of the Axis be multiply'd by 5236, the Product will be 4188.8, the Solidity, the same as by the first Way. If you divide 4188.8 by 1728, the Quotient will be 2.424 Feet. See the Work,

$$21 : 11 :: 8000$$

11

21)88000(4190.47 the Content.

40

190

100

160

13

$$1 : .5236 :: 8000$$

8000

1728)4188.8000(2.424 Feet, the Solidity.

Note, If the Axis of a Globe be 1. the Solidity will be .5236; and if the Circumference be 1. the Solidity will be .016887.

By Scale and Compasses.

Extend the Compasses from 1 to 20 (the Axis) that Extent (turn'd three times over from .5236) will at last fall upon 4188.8 the Solid Content in Inches: or extend the Compasses from 1728 to 8000 (the Cube of the Axis) and that Extent will reach from .5236 to 2.424, the Solid Content in Feet.

Extend the Compasses from 1 to 20 (the Axis) and that Extent (turn'd twice over from 3.1416) will at last fall upon 1256.64, the Superficial Content in Inches; or extend the Compasses from 144 to 400 (the Square of the Axis) and that Extent will reach from 3.1416 to 8.72, the Superficial Content in Feet.

Demonstration.

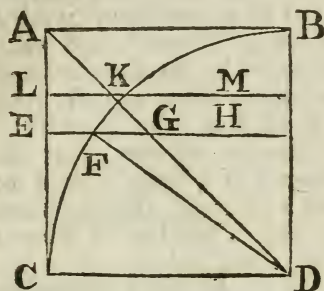
Every Sphere is equal to a Cone, whose perpendicular Axis is the Radius of the Sphere, and its Base a Plane equal to all the Surface of it.

For you may conceive the Sphere to consist of an infinite Number of Cones, whose Bases taken all together, compose the Surface, and whose Vertexes meet all together in the Centre of the Sphere: Hence the Solidity of the Sphere will be gain'd by multiplying its Surface by $\frac{1}{3}$ of its Radius.

Let the Square A B C D, the Quadrant C B D, and the Right angled Triangle A B D be suppos'd all three to revolve round the Line B D, as an Axis; then will the Square generate a Cylinder; the Quadrant an Hemisphere, and the Triangle a Cone, all of the same Base and Altitude.

Then the Square of E H
 (= \square F D) = \square F H + \square

$\square DH$ (but $DH = GH$) and since Circles are as the Squares of their Diameters. (by *Euclid* 12. 2.) the Circle made by the Revolution of EH , must be equal to both the Circles made by the Motion of FH , and GH .



If you take the Circle made by the Revolution of FH from both, there will remain the Circle made by the Motion of GH , equal to the Ring describ'd by the Motion of EF , and thus it will always be, wherever you draw the Line EH or LM , &c.

Therefore the Aggregate or Sum of all the Rings, made by the Revolution of the EF 's must be equal to that of all the Circles, made by the Motion of the GH 's, *i.e.* the Dish-like Solid, form'd by the revolving Rings; will be equal to the Cone, form'd by the Revolution of GH 's, which are the Elements of the Triangle ABD ; that is the Dish-like Solid will be as the Cone $\frac{2}{3}$ of the circumscribing Cylinder, and consequently the Hemisphere must be $\frac{2}{3}$ of it: wherefore the Sphere is $\frac{2}{3}$ of the circumscribing Cylinder

Let the Radius of the Sphere be $r = CD$, then the Diameter will be $2r$: let the Surface of the Sphere generated by the revolving Semi-circle, be call'd S , and that of the Cylinder form'd by the Revolution of $2AC = 2r =$ Diameter, be call'd \int . wherefore, in what was just now prov'd, the Expression for the Solidity of the Sphere in this Notation will be $\frac{1}{3} r S$ and putting c equal to the Circumference of the Base, or for the Periphery of a great Circle of the Sphere, the curve Surface of the Cylinder will be $2 r c$; also $\frac{r c}{2}$ will be the

Area of a great Circle; and this multiply'd by $2 r$, makes $r r c$, which is the Solidity of the Cylinder. Now since \int was put $=$ to $2 r c =$ the Curve Surface of the Cylinder $\frac{\int r}{2}$

(by substituting \int for $2 r c$) will be also $=$ the Solidity of the Cylinder. Now since the Sphere is $= \frac{2}{3}$ of the Cylinder, $\frac{r S}{3} = \frac{2}{3} \frac{\int r}{2}$; that is, $\frac{r S}{3} = \frac{2 \int r}{6} = \frac{\int r}{3}$ wherefore $r S = \int r$, that is, dividing by r , $S = \int$, or the Surface of the Sphere is equal to the Curve-Surface of the Cylinder; but the Curve Surface of the Cylinder was $2 r c$.

Wherefore to find the Area of the Surface of either Sphere or Cylinder, you must multiply the Diameter ($= 2 r$) by

the Circumference of a great Circle of the Sphere, or by the Periphery of the Base.

From this Notation also $\frac{rc}{2}$

the Area of a great Circle of the Sphere is plainly $\frac{1}{4}$ of $2rc$, the Surface of the Sphere; that is, the Surface of the Sphere is Quadruple of the Area of the greatest Circle of it.

Wherefore to $2rc$, the Convex Surface of the Cylinder, add rc , equal to the Area of both its Bases, you will have $3rc$; which shews you, that the Surface of the Cylinder (including its Bases) is to the Surface of the Sphere as 3 to 2; or that the Sphere is $\frac{2}{3}$ of the circumscribing Cylinder, in Area as well as Solidity.

SPHERICAL, of or belonging to a Sphere.

SPHERICAL Geometry, is the Doctrine of the Sphere; particularly of the Circles describ'd on the Surface thereof, with the Method of Projecting the same upon a Plane.

SPHERICAL Trigonometry, is the Art of Resolving Spherical Triangles, *i. e.* from three Parts of a Spherical Triangle given, to find the rest.

SPHERICITY, the Quality of a Sphere, or that whereby a Thing becomes spherical or round.

SPHERICKS, the Doctrine of the Sphere, particularly of the several Circles describ'd on the Surface thereof, with the Method of projecting the same on Planes.

SPHEROID [in Geometry] is a Solid approaching to the

Figure of a Sphere; but not exactly round, but oblong; as having one of its Diameters bigger than the other; and generated by the Revolution of a Semi-Ellipsis about its Axis.

When it is generated by the Revolution of a Semi-Ellipsis about its greater Axis, 'tis call'd an *oblong Spheroid*; and when generated by the Revolution of an Ellipsis about its lesser Axis it is call'd an *oblate Spheroid*.

Daviler observes, that the Contour of a Dome should be half a *Spheroid*. Half a Sphere he says is too low to have a good Effect below.

As for the solid Dimensions of a *Spheroid*, it is $\frac{2}{3}$ of its circumscribing Cylinder; or it is equal to a Cone, whose Altitude is equal to the greater Axis, and the Diameter of the Base, to four times the lesser Axis of the generating Ellipsis.

Or a Spheroid is a Sphere describ'd on its greater Axis, as the Square of the lesser Axis to the Square of the greater: or 'tis to a Sphere describ'd on the lesser Axis, as the greater Axis to the less.

To find the Solid Content of a Spheroid.

Multiply the Square of the Diameter of the greatest Circle by the Length, and that Product multiply again by .5236; this last Product will be the Solidity of the Spheroid.

Let A B the Diameter of the greatest be 33 Inches, and C D (the Length) 55 Inches; the Solidity is required.

S P

33

33

99

99

1089

55

5445

5445

59895

S P

59895

15236

359370

179685

119790

299475

31361.0220 Solidity.

Demonstration.

Every Spheroid is equal to $\frac{2}{3}$ of a Cylinder, whose Base is equal to the greatest Circle of the Spheroid, and its Height equal to the Length of the Spheroid.

Suppose the Figure N T, S N, in the annexed Scheme, to represent a Spheroid, form'd by the Rotation of the Semi-Ellipsis T N S, about its transverse Axis T S.

Let $D = T S$, the Length of the Spheroid, and the Axis of its circumscribing Sphere, and $d = n n$, the Diameter of the greatest Circle of the Spheroid.

SPIRAL } [in the ancient *Ar-*
SPIRE } *chitecture*] is sometimes us'd for the Base of a Column, and sometimes for the *Atragal* or *Tore*.

SPIRAL [in *Geometry*] is a Curve of the Circular Kind, which in its Progress recedes from its Centre, as in winding from the Vertex down to the Base of a Cone.

SPIRAL [in *Architecture*, &c.] is a Curve which ascends, winding about a Cone or Spire; so that all the Points of it continually approach the Axis; by this it is distinguish'd from the *Helix*, which winds after the same Manner round a Cylinder.

SPLAYING of Windows and Doors. See *Bricklayers*.

SPRINGS for Casements of the common or ordinary Fashion are made for about 6*d*. per Piece.

SQUARE [in *Geometry*] is a Quadrilateral Figure; both equilateral and equiangular; or

A SQUARE is a Geometrical Figure, having four equal Sides, and as many Right (or Square) Angles.

To find the Superficial Content.

Multiply the Side into it self, and the Product is the Content.

Let A B C D be a Geometrical Square given, each Side being 14 Feet, Yards or other Mea-

Measure; multiply 14 by it self, and the Product is 196, which is the Superficial Content. See the *Plate. Fig. 5.*

$$\begin{array}{r}
 14 \\
 14 \\
 \hline
 56 \\
 14 \\
 \hline
 196
 \end{array}$$

By Scale and Compasses.

Extend the Compasses from 1 on the Line of Numbers to 14; the same Extent will reach from the same Point turn'd forward to 196.

Demonstration.

Let each Side of the given Square be divided into 14 equal Parts, and Lines drawn from one another crossing each other within the Square; so shall the whole Square be divided into 196 little Squares, as is to be seen in the Figure annexed, equal to the Number of square Feet, Yards or other Measures, by which the Side is measured.

The Properties of a Square are, that its Angles are all right, and consequently its Sides perpendicular; that it is divided into two equal Parts by a Diagonal; that the Diagonal of a Square is incommensurable to its Side.

A Geometrical SQUARE is a plain Figure contain'd under four equal Right Lines, as A B C D, whose Angles at A B C D

are each Right Angles, in which observe, that the Lines A D and C B are the Diagonals; the Lines E H and F G, the Diameters, and the Point I where they all intersect, is the Centre. See *Plate, Fig. 6.*

To describe the Geometrical SQUARE A D E F, whose several Sides shall be equal to the given Line E G F;

First. Make E F = G H, and on F erect the Perpendicular F D = to G H. Then on the Points E and D, with the Distance G H, describe the Arches C C and B B. See *Plate, Fig. 7.*

Secondly, Join A E and A D, and they compleat the Geometrical Square A D E F, as required.

SQUARE, an Instrument of Brass or Wood, having one Side perpendicular or at Right Angles to the other, sometimes made with a Joint to fold for the Pocket; and sometimes has a Back to use on a Drawing Board, to guide the Square.

SQUARE Number is the Product of a Number multiply'd by it self: thus 4 is the Product of 2, multiply'd by 2; or 16 the Product of 4, multiply'd by 4, are Square Numbers.

SQUARE Root, a Number considered as the Root of a second Power or square Number, or a Number by whose Multiplication into it self, a square Number is generated.

Thus the Number 2, being that by whose Multiplication into it self, the square Number 4 is produc'd, is in Respect hereof

hereof call'd a Square Root, or the Square Root of 4.

Geometrical SQUARE, is a Compartment frequently added on the Face of the Quadrant, call'd also a *Line of Shadows*, and *Quadrant*.

Extraction of the SQUARE ROOT.

If a square Number be given; to find the Root thereof, that is, to find out such a Number, as being multiply'd into it self, the Product shall be equal to the Number given, such Operation is call'd, *The Extraction of the Square Root*; which to do, observe the following Directions.

1st. You must point your given Number, that is, make a Point or Prick over the Unit's Place, another upon the Hundred's, and so upon every second Figure throughout.

2^{dly}, Then seek the greatest

square Number in the first Point towards the left Hand, placing the square Number under the first Point, and the Root thereof in the Quotient, and subtract the said square Number from the first Point and to the Remainder bring down the next Point, and call that the Resolvend.

3^{dly}, Then double the Quotient, and place it, for a Divisor, on the left Hand of the Resolvend; and seek how often the Divisor is contain'd in the Resolvend (reserving always the Unit's Place) and put the Answer in the Quotient, and also on the Right-hand Side of the Divisor; then multiply by the Figure last put in the Quotient, and subtract the Product from the Resolvend, (as in common Division) and bring down the next Point to the Remainder (if there be any more) and proceed as before.

A Table of Squares and Cubes, and their Roots.

Root	1	2	3	4	5	6	7	8	9
Squa.	1	4	9	16	25	36	49	64	81
Cub.	1	8	27	64	125	216	343	512	729

Example 1. Let 4489 be a Number given, and let the square Root thereof be requir'd.

4489 (67
36

127)889 Resolvend.
889 Product.

First, Point the given Number, as before directed; then (by the little Table foregoing) seek the greatest square Number in 44 (the first Point to the left Hand) which you will find to be 36, and 6 the Root; put 36 under 44, and 6 in the Quotient, and subtract 36 from 44, and

and there remains 8. Then to that 8 bring down the other Point 89, placing it on the right Hand, so it makes 889 for a Resolvend; then double the Quotient 6, and it makes 12, which place on the left Hand for a Divisor, and seek how often 12 in 88, (reserving the Units Place) the Answer is 7 times; which put in the Quotient, and also on the Right Hand Side of the Divisor, and multiply 127 by 7, (as in common Division) and the Product is 889, which subtracted from the Resolvend, there remains nothing; so is your Work finish'd; and the square Root of 4489 is 67; which Root if you multiply by it self, that is, 67 by 67, the Product will be 4489, equal to the given square Number, and proves the Work to be right.

Example 2. Let 106929 be a Number given, and let the square Root thereof be requir'd.

$$\begin{array}{r}
 \dots\dots\dots \\
 106929(327 \\
 \underline{9} \\
 62)169 \text{ Resolvend.} \\
 \underline{124} \text{ Product.} \\
 647)4529 \text{ Resolv.} \\
 \underline{4529} \text{ Product.} \\
 \dots\dots\dots
 \end{array}$$

First, Point your given Number, as before directed, putting

a Point upon the Units, Hundreds, and Tens of Thousands: then seek what is the greatest square Number in 10, (the first Point) which by the little Table you will find to be 9, and 3 the Root thereof; put 9 under 10, and 3 in the Quotient; then subtract 9 out of 10, and there remains 1; to which bring down 69, the next Point, and it makes 169 for the Resolvend; then double the Quotient 3, and it makes 6, which place on the left Hand of the Resolvend for a Divisor, and seek how often 6 in 16; the Answer is twice; put 2 in the Quotient, and also on the Right Hand of the Divisor, making it 62. Then multiply 62 by the 2 you put in the Quotient, and the Product is 124; which subtract from the Resolvend, and there remains 45; to which bring down 29, the next Point, and it makes 4529 for a new Resolvend. Then double the Quotient 32, and it makes 64, which place on the left Side the Resolvend for a Divisor, and seek how oft 64 in 452, which you will find 7 times; put 7 in the Quotient, and also on the right Hand of the Divisor, making it 647, which multiply'd by the 7 in the Quotient makes 4529, which subtracted from the Resolvend, there remains nothing: So 327 is the square Root of the given Number.

Example 3. Let 2268741 be a square Number given, the Root whereof is requir'd.

2268741)

S Q

S Q

2268741)1506.23

1

25)126

125

3006)18741

18036

30122)70500

60244

301243)1025600

.903729

Remains .121871

Having pointed the given Number, as before directed, seek what is the greatest square Number in the first Point 2, which is one; put 1, the Square under 2, and 1, the Root thereof, in the Quotient; subtract 1 from 2, and there remains 1; to which bring down the next Point, 26, and set it on the right Hand, making it 126; double the 1 in the Quotient, which makes 2; set 2 on the left Hand for a Divisor, and ask how often 2 in 12, which will be 6 times; put 6 in the Quotient, and also on the right Hand of the Divisor, making it 25; multiply (as in common Division) 25 by 2, and subtract the Product, 125 from 126, and there remains 1. Bring down the next Point, 87, and it makes 187 for a new Resol-

vend; and double the 15 in the Quotient, it makes 30 for a new Divisor. Then seek how often 30 in 18, which you can't have; so that you must put 0 in the Quotient, and also on the right Hand of the Divisor, and bring down the next Point, and it makes 18741 for another new Resolvend. Then seek how often 300 in 1874, which will be 6 times; put 6 in the Quotient, and also on the right Hand of the Divisor, multiply and subtract, and the Remainder will be 705. Now, if you have a Mind to find the Value of the Remainder, you may annex Cyphers, by two at a Time, to the Remainders, and so prosecute the Work to what Number of decimal Parts you please; thus, to 705 annex two Cyphers, and it will make 70500 and the Quotient, doubled, is 3012 for a Divisor: Then seek how often 3012 in 7050 (rejecting the Unit's Place) which will be twice; put 2 in the Quotient, and also on the right Hand of the Divisor, and multiply and subtract as before, and the Remainder will be 10256; to which annex two Cyphers, and proceed as before, and you will get a 3 in the Quotient next. So the square Root of the given Number is 1506.23, which being squar'd, or multiply'd, by it self, and the last Remainder added, will make the given Number, as follows.

S Q

S Q

1506.23

1506.23

451869

301246

903738

753115

150623

2268728.8129

The Remainder add — 12.1817

Proof 2268741.0000*Some more Examples for Practice.**Example 1.* $\dot{7}596796$ (2756.228 Root.)

4

47) 359

329

545) 3067

2725

5506) 34296

33036

55122) 126000

110244

551242) 1575600

1102484

5512448) 47311600

44099584

3212016*Example*

Example 2. $\overset{\cdot}{7}\overset{\cdot}{5}\overset{\cdot}{1}\overset{\cdot}{4}\overset{\cdot}{1}\overset{\cdot}{7}\overset{\cdot}{.}\overset{\cdot}{5}\overset{\cdot}{7}\overset{\cdot}{4}\overset{\cdot}{5}$ (866.4 Root.
64

$$\begin{array}{r} 166) 1114 \\ 996 \\ \hline \end{array}$$

$$\begin{array}{r} 1726) 11817 \\ 10356 \\ \hline \end{array}$$

$$\begin{array}{r} 17328) 146157 \\ 138624 \\ \hline \end{array}$$

$$\begin{array}{r} 173364) 753345 \\ 693456 \\ \hline \end{array}$$

$$\begin{array}{r} 59889 \\ \hline \end{array}$$

If the given Number be a Unit's Place of the whole Number, as in this last Example, and in that following.

Example 3. Let 656714.37512 be given, to find the square Root.

$\overset{\cdot}{6}\overset{\cdot}{5}\overset{\cdot}{6}\overset{\cdot}{7}\overset{\cdot}{1}\overset{\cdot}{4}\overset{\cdot}{.}\overset{\cdot}{3}\overset{\cdot}{7}\overset{\cdot}{5}\overset{\cdot}{1}\overset{\cdot}{2}\overset{\cdot}{0}$ (8103.79 Root.
64

$$\begin{array}{r} 161) 167 \\ 161 \\ \hline \end{array}$$

$$\begin{array}{r} 16203) 61437 \\ 48609 \\ \hline \end{array}$$

$$\begin{array}{r} 162067) 1282851 \\ 1134469 \\ \hline \end{array}$$

$$\begin{array}{r} 1620749) 14838220 \\ 14586741 \\ \hline \end{array}$$

Remains 251479

In

In this Example there are five Places of Decimals; therefore put a Cypher to it, to make it even, that so there, may a Point fall upon 4 the Unit's Place.

To find the Square Root of a Fraction.

If it be a decimal Fraction, the Work differs nothing from the Examples afore-going, only you must be mindful to point your given Number aright, for (as was before directed) the Number of Places must always be made even, and then begin to point at the right Hand, as in whole Numbers.

If it be a vulgar Fraction, it must be reduc'd to a Decimal.

I shall give an Example or two in each Case, and so conclude.

Let .125 be a decimal Fraction given, whose square Root is requir'd; and let it be requir'd to have four Places of Decimals in the Root.

$$\begin{array}{r}
 .12500000(.3535 \\
 9 \\
 \hline
 65)350 \\
 325 \\
 \hline
 703)2500 \\
 2109 \\
 \hline
 7065)39100 \\
 35325 \\
 \hline
 3775
 \end{array}$$

In this Example there must be five Cyphers annex'd, because two Places in the Square, make but one in the Root.

Let the Square Root of .00715 be requir'd.

$$\begin{array}{r}
 .007150(.084 \\
 64 \\
 \hline
 164)750 \\
 656 \\
 \hline
 94
 \end{array}$$

In this a Cypher is added to make the Places even.

Let $\frac{2}{3}$ be a vulgar Fraction given, whose square Root is requir'd.

$$\begin{array}{r}
 8)7000 \\
 64 \\
 \hline
 60 \\
 56 \\
 \hline
 40 \\
 40 \\
 \hline
 .. \\
 81)87500000(.9354 \\
 81 \\
 \hline
 183)650 \\
 549 \\
 \hline
 1865)10100 \\
 9325 \\
 \hline
 18704)77500 \\
 74816 \\
 \hline
 2684
 \end{array}$$

Reduce

Reduce this $\frac{2}{3}$ to a Decimal, it makes 875; to which annex Cyphers, and extract the square Root, as if it was a whole

Number. So the Root is .935.4
Let $\frac{1}{2}$ be a vulgar Fraction, whose square Root is requir'd.

96|0)3.0000000|0

....

288

—

120

96

—

240

192

—

480

480

—

...

. . . . Root.

(.00312500(.0559.

25

—

105)625

525

—

1109)10000

9981

—

19

In extracting the Root of this, because the first Point consists of Cyphers, there must be a Cypher put first in the Quotient.

To prove this Rule, square the Root, and to the Product add the Remainder, as was before directed. To square a Number, is to multiply it by it self; and to cube it, is to multiply the Square of the Number, by the Number it self.

SQUARING [with *Mathematicians*] signifies the making a Square equal to a Circle. Thus the Quadrature or squaring of the Circle, is the finding a Square equal to the Area of a Circle.

STABLE, a Building wherein Horses are kept: It should be plac'd in a good Air, made

of Brick, and not of Stone, the first being most wholesom and warmest; for Stone will sweat upon the Alteration of the Weather, which begets Damps and causes Rheums in Horses, neither should there be any unfavoury Gutter, Sink, Jakes, Hog-Sties or Hen-Rooft near it.

The Rack should be plac'd neither too high nor too low, and so well posted, that the Hay-Dust fall not into his Neck, Face or Mane: the Manger ought to be of an indifferent Height, made deep, and of one intire Piece, as well for Strength as Conveniency, and the Floor must be pav'd and not plank'd, which is liable to a great many Inconveniencies; nor should there be any Mud or Loam Wall near it, for the Horse will

eat it, and that will make him sick, Loam and Lime being suffocating Things, which will infect and putrify the Blood, endanger the Lungs, and so spoil his Wind.

There should also, if Con-
venience will permit, be Space
in the Stable for a Bed for Ser-
vants to lie in; and in the Nook
or Corner a great Rack, on
which to hang Halters, Saddles,
and other Utensils.

STAIRS [in *Building*] are
the Steps whereby we ascend
and descend, from one Story of
an House to another.

As to the Dimensions of
Stairs, they are differently as-
sign'd by different Authors;
but however, they agree in
this, that they must not be
more than six, nor less than
four Inches high; nor more
than 18, nor less than 12 In-
ches broad; nor more than 16,
nor less than six Foot long, each
Stair.

But these Measures have
only Respect to large and
sumptuous Buildings; for in
common and ordinary Houses,
they may be something higher
and narrower, and much shorter;
yet even in these, the
Stairs are not to exceed seven,
or (at most) eight Inches in
Height; for if they do, they
will be difficult to ascend:
neither ought they to be less
than nine or ten Inches in
Breadth, nor ought their Length
to be less than three.

To reduce the Dimensions of
Stairs to some natural, or at
least Geometrical Standard,
Vitruvius borrows the Propor-

tions of the Sides of a Rect-
angle Triangle, which the an-
cient School express'd by the
Numbers 3, 4 and 5; that is,
three for the Perpendicular
from the *Stair Head* to the
Ground; 4 for the *Ground*
Line it self, or Recession from
the Wall (says Sir *Henry Woot-
ton*) and the fifth for the whole
Slope and Inclination, from the
Edge of one Stair to that of
another.

But this Rule is set aside by
modern Builders, and that with
good Reason; for on this Prin-
ciple, the lower the Stairs, the
narrower they must be; and
for Instance, Stairs four Inches
high (such as are found men-
tioned in ancient Architects)
must be but $5\frac{1}{3}$ Inches broad,
and if a Stair be but six Inches
high, it must be but eight Inches
broad, whereas in this Case, we
seldom make them less than a
Foot broad.

One Rule to be regarded in
making of Stairs, is that they
be laid according to the *Ita-
lian* Phrase, *con un tantino*
de scarpa; i. e. *somewhat slop-
ing*, or a little higher behind,
that the Foot, may as it were,
both ascend and descend at the
same time; which tho' it is ob-
serv'd but by few, is found to
be a secret and delicate Decep-
tion of the Pains in ascending.

Of making Stairs] Tho' there
have been Rules laid down for
the Height and Breadth of
Stairs; yet Workmen are not
to be so strictly ty'd up to
those Rules, as not in the least
to vary from them; for they
must always observe, to make
all

all the Stairs of the same Stair-Case of an equal Height and Breadth; in Order to which they must first consider the Height of the Room, as also the Width or Compass they have to carry up the Stairs in.

Then in Order to find the Height of each particular Stair, they ought first to propose the Height, and to divide the whole Height of the Room by the propos'd Height, which being done, the Quotient will shew the Number of Stairs; but if the Division does not fall out exact, but that there be a Remainder; then in this Case take the Quotient, (without regarding the Remainder) for the Number of Stairs, and by that Number divide the whole Height of the Room, so the Quotient will give you the exact Height of each Stair; as for Example.

Suppose the whole Height of the Room to be 9 Foot, 3 Inches, and suppose you design'd to make each Stair 6 Inches high. Turn the whole Height of the Room into Inches, which will be 111 Inches; divide these by 6, the Quotient will be 18, and 3 remaining; there let the Number of Stairs be 18, and by it divide 111, and the Quotient will be $6\frac{3}{18}$, or $6\frac{1}{6}$ Inches, which must be the exact Height of each Stair.

Then to find the Breadth of each Stair, divide the Width or Compass (that you have to carry them up in) by the Number of Stairs, and the Quotient will give the exact Breadth of each Stair.

STAIR-CASE, is an Ascent inclos'd between Walls, or a Ballustrade, consisting of Stairs or Steps, with Landing Places and Rails; serving to make a Communication between the several Stories of a House, and sometimes it is us'd to signify the whole Frame of a Pair of Stairs only.

The Construction of a compleat Stair-Case, says Sir *Henry Wootton*, is one of the most curious Works in Architecture, and the common Rules are these that follow.

1. That it have a full free Light, to prevent Accidents of slipping, falling, &c.

2. That the Space over-head be large and airy, which the *Italians* call *un bel Sfogolo*, i. e. *good Ventillation*, because a Man spends much Breath in mounting.

3. That the half Paces or Landing Places be conveniently distributed for reposing by the Way.

4. That to avoid Rencounters, and also to gratify the Eye of the Beholder, the *Stair Case* be not too narrow; but this last is to be regulated by the Quality of the Building; and that in Royal Buildings, the principal Ascent be at least 10 Foot. For a little Stair Case in a great House, and a great one in a little House, are both equally ridiculous.

5. That great Care be taken in the placing the Stair Case, so that the Stairs may be distributed without Prejudice to the rest of the Building, there being much Nicety requir'd in making this Choice.

The Kinds of Stair Cases are various; in some the Stairs are *strait*; in others, *winding*; in others, *mixt* of both.

1. Of *strait Stairs*, some fly directly forwards, and are called *Flyers*; others are square; others triangular, and others are call'd *French Flights*.

2. Of *winding Stairs*, which are also call'd *Spiral* or *Cockle Stairs*, some are square, some circular, and some elliptical or *oval*.

And these again are various, some winding round a Solid, and others an open Newel.

Lastly *mix'd Stairs* of *strait* and *winding*, they are also of various Kinds, some are call'd *Dog-legg'd*, others there are that wind about an open Newel, and fly about a square open Newel.

Stair-Cases being of that Importance in Building, it will be necessary to give a particular Account of each Kind.

I. *Strait Stairs* are such as always fly, i. e. proceed in a Right Line, and never wind, and for that Reason are by some call'd *Flyers*. Of these there are several Kinds.

1. *Strait Flyers*, or *Plain Flyers*, which proceed directly from one Floor to another, without turning to the right or left; and are seldom us'd, except for Garret or Cellar Stairs in ordinary Houses.

2. *Square Flyers*, which fly round the Sides of a square Newel, either solid or open; having at every Corner of the Newel a square $\frac{1}{4}$ Step, taking up $\frac{1}{4}$ of a Circle, so that they fly from one half Pace or Step

to another, and the Length of the Stairs is perpendicular to the Side of the Newel.

3. *Triangular Flyers*, which fly round by the Sides of a triangular Newel, either solid or open, having at each Corner of the Newel a trapezial half Step, taking up $\frac{2}{3}$ of a Circle: so they fly from one half Step to another, and their Length is perpendicular to the Side of the Newel.

Palladio tells us, that triangular Stairs are to be seen in some ancient Edifices, and of these Sort, he says, are those of the Cupola of St. *Maria Rotunda*, which are open in the middle, and receive Light from above. Those also of *Sancto Apostollo* in the same City, are of the same Kind.

4. *French Flyers*, which fly first directly forwards, till they come within the Length of a Stair of the Wall, and then have a square half Space, from which you immediately ascend to another half Pace, from which you ascend immediately to another half Pace, from which the Stairs fly directly back again, parallel to their first Flight.

II. *Winding Stairs* are such as always wind and never fly, of these also there is great Variety: for,

Some wind round a Circle, others round an Ellipsis or Oval; others round a Square, and others round an equilateral Triangle: of each of these some wind round a solid Newel and others, an open or hollow Newel. Again, some are set up

upon Columns, and some Stairs are double, and some quadruple, of each of which I shall speak briefly.

1. *Circular winding Stairs*; of which there are four Kinds, viz. such as wind about a solid Newel, the fore-edge of which being in a Right Line, pointing to the Centre of a Newel; commonly us'd in Church Steeples and great old Houses.

Secondly. Such as wind round an open Newel, the fore-side of which being in a Right Line, pointing to the Centre of the Newel, as those in the *Monument of London*.

Thirdly. Such as wind round a solid Newel only, the fore-side of each an Arch of a Circle, either concave or convex, pointing near to the Circumfe-

rence of the Newel.

In these the Stairs are much longer than in the common winding Stairs.

Of these there may be two Kinds; for their Ich-nography being drawn, the Stairs may be contriv'd to be either Concave or Convex on the fore-side.

Fourthly. There are other Stairs in all Respects like those last describ'd, only they have an open Newel.

These Kind of Stairs are said to have been invented by *Anthony Barbaro*, a Gentleman of *Venice*.

Any of these winding Stairs take up less Room than any other kind of Stairs whatsoever.

In Stairs that wind round a solid Newel Architects

make the Diameter of the Newel $\left\{ \begin{array}{c} \frac{1}{2} \\ \frac{1}{4} \\ \frac{1}{3} \\ \frac{1}{2} \\ \frac{3}{7} \end{array} \right\}$ of the Diameter of

the whole Stair Case; according as the Stair-Case is in Bigness; for if the Stair-Case be very small, they make the Newel but $\frac{1}{2}$ of its whole Diameter; and if very large, then $\frac{3}{4}$, and so proportionably of the rest.

In Stairs that wind round an open Newel, *Palladio* orders the Newel to be $\frac{1}{2}$ the

Diameter of the whole Stair-Case, tho' then there does not appear any Reason why these open Newels ought not to be proportion'd to the Size of the Stair-Case, as well as the solid ones.

Then as to the Number of Stairs in each Revolution, he orders,

that if the Stair-Case be $\left\{ \begin{array}{c} 6 \text{ or } 7 \\ 8 \\ 9 \text{ or } 10 \\ 18 \end{array} \right\}$ Foot Diameter, then

there may be $\left\{ \begin{array}{c} 12 \\ 16 \\ 20 \\ 24 \end{array} \right\}$ Stairs in one Revolution about the Newel.

Elliptical winding Stairs. Of these there are two Kinds, the one winding round a Solid, and another round an open Newel. They are much of the same Nature with circular Stairs, except that in those the Newel is a Circle, and in these an Ellipsis or Oval.

These Kinds of Stairs are very handsome and pleasant, (says *Palladio*) because all the Windows and Doors are commodiously plac'd in the middle and Head of the Oval. He tells us he has made one of these with an open Newel, at the Monastery of *Charity* at *Venice*.

Square winding Stairs. These wind round a square Newel, and the fore-side of each Stair is a Right Line, pointing to the Centre of the Newel.

Triangular winding Stairs, are such as wind round a triangular Newel, the fore-side of which being a Right Line, pointing to the Centre of the Newel. And because the Newel may be either solid or open, therefore there are two Kinds of them.

Columniated winding Stairs. *Palladio* mentions a Stair-case in *Pompey's Portico* at *Rome*, set on Columns, so as that the Light they receiv'd from above, might distribute it to all Parts alike: such another Pair were made by *Bramante* (an excellent Architect) at *Belvedere*, the Pope's Palace.

Double winding Stairs. *Scamozzi* mentions a Stair-case of this Form, made by *Piedro del Bergo*, and *Jean Coffin*, at *Sci-*

amberg in *France*, in the King's Palace. They are so contriv'd that two Persons, the one ascending and the other descending, shall not meet together or come at one another.

Dr. Grew describes a Model of this kind of *Stair-Case*, in the *Museum* of the *Royal Society*. The Foot of one of the *Stair-Cases*, he says, is opposite to the other, and both make a parallel Ascent, and within the same Cylinder. The Newel in the middle is hollow, and built with long Apertures to convey Light from Candles, plac'd at the Bottom, and on the Sides of the Newel in both Cases.

Quadruple winding Stairs. *Palladio* mentions a Stair-case of this Form, which King *Francis I.* caused to be made in the Castle of *Chambor*, near *Bloyse*: it consists of four *Stair Cases* carried up together, having each its several Entrance and going up one over another, in such Manner, as that being in the middle of the Building, the four serve for four Apartments; so that the People of the one need not go up and down the Stairs of the other; yet being open in the middle, they all see each other pass, without any Hindrance to one another.

Mix'd STAIRS are such as partly fly, and partly wind; whence some call them *Flyers* and *Winders*, of these there are several Kinds, as

Dog-legg'd Stairs, which first fly directly forwards, then wind a Semi-circle, and then fly

fly directly backwards, parallel to that.

Square Flyers and Winders. These have a square Newel, either solid or open, and fly by the Sides of the Newel, winding a Quadrant of a Circle at each Corner.

Solid and open newel'd Flyers and Winders, are of two Kinds; the one winds the Quadrant of a Circle about a solid Newel; then flies by the Side of a square open Newel, then winds again by the Side of a solid Newel, then flies again as before, and so alternately. The other flies first, then winds, then flies again alternately.

The Price of Stair-Cases is various, according to their various Kinds, Sizes and Curiosity of Workmanship.

They are sometimes rated at so much *per Piece*, and sometimes at so much *per Square*.

An ordinary Pair of Stairs with Flyers and Winders, of about 6 Foot and 4 Foot, made of Elm Boards, are valued at 2 s. 6 d. and 2 s. 8 d. *per Stair*; the Workmen finding all Materials, as Boards, Nails, &c. but if the Materials are found by the Owner, then 9 d. or 10 d. *per Stair* is a good Allowance for Workmanship.

But as for Stair-Cases that have an open Newel, with a Landing Place at every sixth or eighth Stair, being about three Foot all the Way; these Stairs with Rails, Ballusters, String - Boards, Posts, Balls, Pendants, and such other Ornaments, may very well be worth 4 s. 6 d. 5 s. or 6 s. *per Stair*.

STANCHIONS, the same as *Punchins*.

STATUES, a Figure or Statue rais'd over an Order or Building, says M. *Le Clerc*, may have its Height equal to one third of that Column, or to four ninths of it, if the Statue have no Niches.

If it be bigger, it will make the Building appear little; and if it be less, for Instance only a fourth or little more, the Building will appear by much the larger.

It is observable, adds he, that in Proportion, as a Statue is rais'd above the Eye, it appears to diminish in Bulk; till such time, as being elevated to a very great Pitch, it becomes almost imperceptible.

For this Reason some Architects contend, that the Sculptor must always accommodate his Figures to their Height, and increase their Bigness, just as their Elevation increases, to the End that they may always appear of a reasonable Size.

But as the Orders of Columns are diminish'd in Proportion as they rise over one another, it would happen that the Statues in this Case would become too big for the Order.

An Architect must always proportion his Figures to the Orders, and the Stories where they are to be plac'd; unless it happen to be in a close narrow Place, as in a Stair-Case or Dome, for in that Case, the Orders or the Statues may be enlarged in Proportion. But notwithstanding, Care must be taken not to run into Excess, it being

being better that they should appear too little, than too big.

Instead of placing Statues to finish the uppermost Stories, one may have Vases, Torches, Pots of Incense, Trophies and the like Ornaments; which will suit better with such Places than Human Figures; unless those represent the tutelar Angels, appointed for the Guard and Protection of the Building.

STEEL, is an Iron that is very hard in its Nature, and sometimes is made so by Art; it has the same Qualities as Iron.

Some have given Steel the Name of *Chalybs*, because anciently brought from a Town in *Assyria*, named *Calibone*, where very good Steel was made; but that of *Damascus* is preferr'd before all others, and it is found by Experience, that Swords made of it, cut Iron it self.

Our Way of *Steel-making* is to chuse such Iron as is apt to melt, and yet hard, and which nevertheless may be easily wrought with the Hammer; for the Iron which is made of Vitriol Ore, tho' it may melt, yet it is soft, fragil or eager. Let a Parcel of such Iron be heated red hot, and let it be cut into small Pieces, and then mix'd with that Sort of Stone which easily melts, then set in the Smith's Forge or Hearth a Crucible, or Dish of crucible Metal, a Foot and a half broad, and a Foot deep; fill the Dish with good Charcoal, compass the Dish about with loose Stores, which may keep in the Mixture of Stones and Pieces of Iron put thereon:

As soon as the Coal is thoroughly kindled, and the Dish is red hot, give the Blast, and let the Workman by little and little put in all the Mixture of Iron and Stone he designs; when it is melted, let him thrust into the middle of it, 3, 4, or more Pieces of Iron, and boil them therein five or six Hours, with a sharp Fire, putting in his Rod; stir often the melted Iron, that the Pieces of Iron may imbibe the smaller Particles of the melted Iron, which Particles consume and thin the more gross Particles of the Pieces of Iron, and are, as it were, a Ferment to them, and make them tender.

Let the Workman now take one of the Pieces out of the Fire, put it under the great Hammer to be drawn into Bars and wrought, and then hot as it is, plunge it immediately into cold Water: being thus tempered, let him again work it upon the Anvil, and break it, and looking upon the Fragments, let him consider whether it looks like Iron in any Part of it, or if it be wholly condens'd and turn'd into *Steel*.

Then let the Pieces be all wrought into Bars, which being done, give a fresh blast to the Mixture, adding a little fresh Matter to it, in the Room of that which has been imbib'd by the Pieces of Iron, which will refresh and strengthen the Remainder, and make the Pieces of Iron put again into the Dish, the purer; every which Piece, let him, as soon as it is red hot, beat into a

Bar

Bar on the Anvil, and cast it hot as it is into cold Water: and thus Iron is made into *Steel*, which is much harder and whiter than Iron.

STEEL-YARD [in *Mechanicks*] is a kind of Balance, call'd *Statera Romana*, or the *Roman Balance*; by Means whereof the Gravity of different Bodies are found by the Use of one single Weight.

It consists of an Iron Beam, A B, wherein a Point is taken at Pleasure, as C, and on this a Perpendicular rais'd C D. On the less Arm A C is hung a Scale or Bason [or else are hung Hooks] as H G to receive the Bodies that are to be weigh'd.

The Weight *I* is shifted this Way and that Way on the Beam, till it is a Counter-balance to one, two, three, four, &c. Pounds, either plac'd in the Scale (or hung upon an Hook) and the Points are mark'd wherein *I* weighs, as one, two, three or four, &c. Pounds. See the *Plate, Fig. 8.*

From this Construction of the *Steel-Yard*, the Manner of using it is apparent, but the Instrument being very liable to Deceit, ought not to be countenanc'd in Commerce. See *Balance.*

Spring STEEL-YARD, a Kind of portable Balance, serving to weigh any Matter from about one to forty Pounds.

It is compos'd of a Brass Tube, into which goes a Rod, and about that is wound a Spring of tempered Steel, in a spiral Form. On this Rod are

the Divisions of Pounds and Parts of a Pound, which are successively made by hanging on to a Hook, fastened to the other End, 1, 2, 3, 4, &c. Pounds.

Now the Spring being fastened by a Screw to the Bottom of the Rod, the greater Weight is hung on the Hook, the more will the Spring be contracted, and consequently a greater Part of the Rod will come out of the Tube; the Proportions of which greater Weights, are indicated by the Figures appearing against the Extremity of the Tube.

STEENING of *Wells*. See *Bricks.*

STEEPLE, is an Appen-dage erected on the Western End of a Church, to hold the Bells.

*Steeple*s are named from their Form, either *Spires* or *Towers*.

*Steeple*s are such as ascend continually, diminishing either conically or pyramidally.

The latter are mere Parallelopipeds, and are cover'd at Top, Plat-Form like.

In each Kind there is usually a Sort of Windows or Apertures, to let out Sounds, and so contriv'd at the same time as to drive it down.

Masius in his Treatise of Bells, treats likewise of Steeples.

The most remarkable Steeple in the World, is that at *Pisa*, which leans all on one Side, and appears every Moment ready to fall; yet without any Danger.

He observes that this odd Dispo-

Disposition is not owing to the Shock of an Earthquake, as is generally imagin'd; but was so contriv'd at first by the Architect; as is evident from the Ceilings, Windows, Doors, &c. which are all in the Level.

STEPS, the same as *Stairs*.

STEREOMETRY, is that Part of *Geometry*, which teaches how to measure solid Bodies, *i. e.* to find the Solidity or solid Content of Bodies; as Cylinders, Cubes, &c.

STEREOTOMY is the Art or Science of cutting Solids, or making Sections thereof; as in Profiles of Architecture, in Walls and other Solids to be cut.

STILES [in *Foinery*, &c.] are the upright Pieces, which go from the Bottom to the Top in any Wainscot.

STILLATORY, the Room in which a Still or Alembick is set up for Distillation.

STILOBATUM, the Body of the Pedestal of any Column.

STOCK-BRICKS. See *Bricks*.

STONE, is a hard, solid mineral Body, neither fusible nor malleable, form'd in Succession of Time in the Body of the Earth.

Of the Origin and Formation of STONES.

Mr. *Tournefort*, after a curious Survey of the famous Labyrinth of *Crete*, observes that several People had engraven their Names in the living Rock, wherewith its Walls were form'd; and what was

very extraordinary, the Letters whereof they consisted, instead of being hollow, as they must have been at first (being all cut with the Points of Knives) were prominent, and stood out from the Surface of the Rock, like so many *Basso Relievo's*.

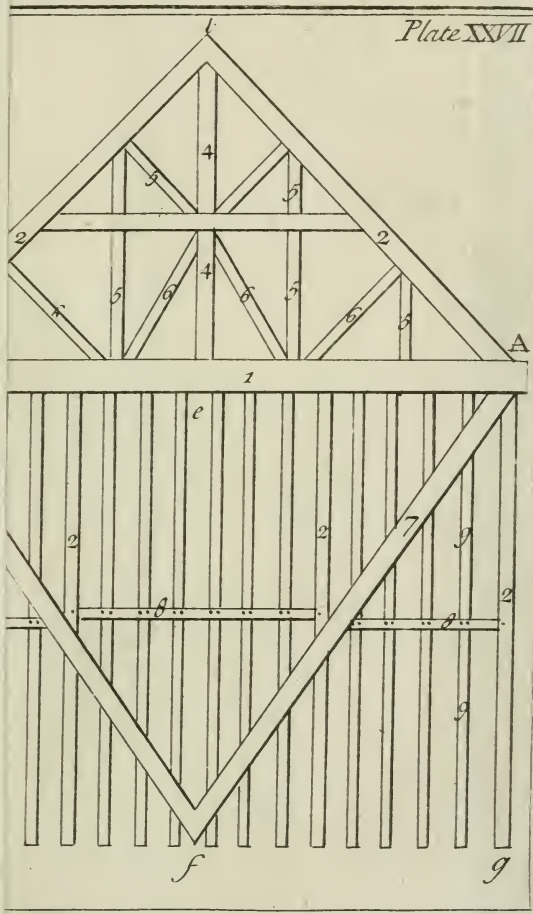
This Phenomenon is no other Way to be accounted for, then by supposing the Cavities of the Letters to have been fill'd up insensibly with a Matter issuing out of the Surface of the Rock; and which even issued with greater Abundance than was necessary for filling the Cavity.

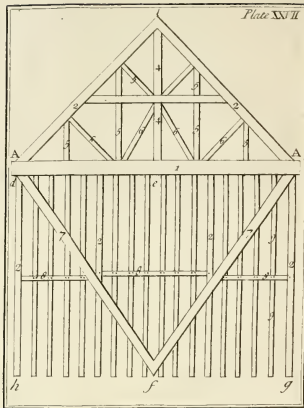
The Wound of the Knife is heal'd up after the same Manner as the Fracture of a broken Bone is consolidated by a *Callus*, form'd of the extravasated nutritious Juice, which rises above the Surface of the Bone; and this Resemblance is the more proper, the Matter of the Letters being found whitish, when the Rock it self was greyish,

Something very like this is found in the Barks of Trees, in which Letters have been cut with a Knife.

Mr. *Tournefort* supports his Opinion by similar *Callus*, apparently form'd in several other Stones, which re-unite them after they have been broken by Accident.

From these Observations it follows, that there are Stones which grow in the Quarries, and consequently that they are fed, and that the same Juice that nourishes them, serves to re-unite their Parts, when broken





broken, just as in the Bones of Animals, and Branches of Trees when kept up by Bandages ; and in fine, that they do vegetate :

If so, there is no Room to doubt, but that they are organiz'd, or that they draw their nutritious Juice from the Earth.

This Juice must be first filtrated and prepar'd in their Surface ; which may here be accounted as a kind of Bark ; and hence it must be convey'd to all the other Parts.

It is highly probable that the Juice which fill'd the Cavities of the Letters, was brought thither from the Bottom of the Roots of the Rock ; nor is there any more Difficulty in conceiving this, then in comprehending how the Sap should pass from the Roots of our largest Oaks to the very Extremity of the highest Branches.

It must indeed be own'd, that the Heart of these Trees is extremely hard ; and yet those of *Brasile*, &c. call'd Iron Wood, Ebony, &c. are much harder.

Coral is as hard in the Sea as out of it ; and Sea-Mushrooms, which all Persons allow to grow, are real Stones, and so, like the common Stones, are us'd in *America* in making Lime of.

It was never doubted but that Shells grew by Means of a nutritious Juice ; and yet this Juice is convey'd along the narrow Canals of these very hard Bodies, as well as those of Plants, which are not near so hard.

So that it must be allow'd that some Stones do vegetate and grow like Plants. Neither is this all ; but there is great Probability that they are generated in the same Manner ; at least, there is Abundance of Stones, the Generation of which is inconceivable, except they be suppos'd to come from a kind of Seed, in which the organical Parts of the Stones are wrapt in, as little as those of the largest Plants are in their Grains.

The Stones call'd *Cornu Ammonis*, *Lapis Judaicus*, *Astroites* ; those of *Bologne* and *Florence*, the several Kinds of *Pyrites*, and a great Number of others, suppose their several Seeds ; as Mushrooms, Truffles, and Mosses of various Kinds, whose Seeds were never yet discovered.

How should the *Cornu Ammonis*, which is constantly in the Figure of a Volute, be form'd without a Seed, containing that same Structure in little ? where are the Moulds in which they were form'd ? and who moulded them so artfully ? so far is it from being so, that these Stones are found in the Earth, like common Flints, nor have any Thing like Mould been ever discovered.

Mr. *Tournefort* examin'd the several Kinds of Stones above-mention'd, and finds them under the same Necessity of Seed. Again as to the immense Quantity of Flints, wherewith the *Crau of Arles* is covered, is a strong Argument in Behalf of this Theory.

The Country there for 2^o Miles round, is full of round Flints; which are still found in equal Abundance, to what Depth soever you dig.

M. *Tournefort* observes, that among the Seeds of Stones, there are some which don't only grow soft by the Juices of the Earth; but also become liquid.

These then, if they penetrate the Pores of certain Bodies, grow hard, petrify and assume the Figure or Impression of the Body; thus those that are call'd *Pectinetes*, *Conchytes*, *Ostracites*, &c. are real Stones, the Liquid Seeds of which have insinuated into the Cavities of the Shells, call'd *Pecten*, *Concha*, &c.

On the Contrary, if these liquid Seeds fall on *Flints*, on Shells, Sand, &c. they inclose those several Bodies, and fixing between them, form a kind of Cement, which yet grows like other Stones.

It is highly probable, that such Rocks as are only an Assemblage of masticated Flints, have been form'd by a Number of those liquid Seeds; in like Manner as the Quarries full of Shells, unless the Rocks have invested these Bodies in their Growth.

He likewise adds, that there are Seeds of real Stones, inclos'd in the Spawn of certain Shell-Fish; as well as that hard solid Matter, destin'd to the forming of their Shells.

There is a particular kind of Shell-Fish, call'd *Pholas*, which is never found any where

but in the Cavity of Flints, which are always found exactly fitted to receive them.

Now it is highly improbable that the Fish should come and dig such a Niche to spawn in; it is much more likely that the Stones they are found inclos'd in, were at first soft, and that the Matter they are form'd of, was originally found in the Spawn, in like Manner as the Matter which form'd the Egg-Shell, is really found in the Seed thereof.

From the Whole he concludes, that the Seed of Stones, and even of Metals, is a kind of Dust which probably falls from them, while they are alive, *i. e.* while they continue to vegetate, as above.

This Dust may be compar'd to the Seeds of several Plants, as those of *Ferns*, *Capillaries*, *Mosses*, *Truffles*, and the like, which no Microscope ever yet discovered, altho' their Existence is not at all doubted.

Probably Flints and Pebbles are among Stones, what Truffles are among Plants. *Pliny* assures us, that *Theophrastus*, &c. believ'd that Stones produc'd Stones; so that this Opinion does not seem improbable.

M. *Geoffry* accounts for the Origin and Formation of Stones, after another Manner.

He lays it down as a Principle, that all Stones without Exception, have been fluid; or at least a soft Paste now dry'd and harden'd; witness the Stones, wherein foreign Bodies are found; also figured Stones, &c.

As to the Kinds of Stones, They are various, as *Marble, Fire-Stone, Purbeck-Stone, Rag-Stone, Alabaſter, Free-Stone,* and *Common-Stone.* All which have been already treated on in their proper Places, Alphabetically.

As for *Free-Stone*, there is a Sort of Stone commonly dug in the Peninsula of *Portland*, in *Dorſetſhire*, and commonly known by the Name of *Free-Stone*, which is much us'd in Building, it being much ſofter and whiter than *Purbeck-Stone*, and is uſually rais'd out of the Quarries in bigger Blocks than *Purbeck-Stone*.

Some Authors call this *Portland-Stone, Free-Stone*, though there is a Sort of Stone found in *Oxfordſhire*, which is call'd *Free-Stone*, and *Rigate-Stone* or *Fire-Stone*, is by ſome Authors call'd *Free-Stone*.

Common-Stone needs no Deſcription, it being that which is commonly us'd and found almoſt every where; and of which I ſhall principally treat here.

Of the Nature of Stones.

The Honourable Mr. *Boyle*, tells us he could eaſily ſhew, that Ways (hitherto unus'd) might be found out (as he has partly try'd) to examine the Nature and Goodneſs of *Marble, Alabaſter*, and other Stones.

That a competent Knowledge of the Sap that is to be found in Stones, employ'd in Building, is of ſo great Importance, that experienc'd Artifi-

cers have own'd, that the ſame Sort of Stone, taken out of the ſame Quarry, if dug at one Seaſon, will moulder away in a very few Winters, whereas being dug at another Seaſon, it will brave the Weather for very many Years, not to ſay Ages; and again, as there is ſome Sort of Stone that will decay in a few Years, ſo on the contrary there are others which will not attain to their full hardneſs in 30 or 40 Years, or a much longer time.

A certain Author ſays, that there are in ſome Places, Quarries of ſolid and uſeful Stone, which is employ'd about ſome ſtately Buildings, which is of ſuch a Nature, that tho' being dug at a certain Seaſon of the Year, it proves good and durable, yet being employ'd at a wrong time, it makes but ruinous Buildings, as has been found by ſad Experience.

As to the Method of drawing Stones, i. e. getting them out of the Quarry. See *Quarry*.

A Load of Stone how much. }
25 Foot of Stone are reckon'd to the Load Superficial Meaſure, not 25 ſolid Feet; but meaſured upon the Face of the Stone.

To underſtand this Matter the more clearly, it is to be obſerv'd, that every ſquared Stone has ſix Plains or Sides, viz. the upper and under Bed, the Face and the Back, and the two Heads or Ends.

Of theſe ſix Planes, thoſe two oppoſite ones, that are the cleaving Way of the Stone (and which in the Quarry lay paral-

parallel to the Horizon) are call'd the *Beds*; and of the best of the four Planes that are perpendicular to theie (and consequently are the breaking Way of the Stone) they make the Face and the Plane opposite to the Face (which commonly goes rough, as it comes from the Quarry) they call the *Back* of a Stone; and the other two perpendicular Planes, are call'd the Heads or Ends.

The Quantity of a Chord of Stones.] In some Places of *Kent*, Stones are sold by the Chord, consisting of 27 solid Feet, *viz.* three Feet long, three broad, and three high.

How much Walling a Load of Stones will do.] A Load of Stones will wall but about 20 Feet of 18 Inch Wall, which is accounted a Medium between what some say, speaking of the two Extremes, 15 and 25.

Soft Stones, how they are wrought smooth.] Some Stones are too soft to bear a good Edge; so that when they are scapt and wrought smooth, their Edges crumble off, and therefore (in this Case) to make them smooth, they proceed thus: After they are scapt, they have an old Card (such as Wool is carded with) and with it they work out the Strokes of the Ax; then bring it to a better liking, by rubbing it with a Piece of the same Stone.

The Price for drawing and carrying Stones, is for the drawing, about 3 s. the Load; and carrying (if it be not above half

a Mile) 2 s. Some say they have drawn them for 9 d. the Load, when they lay almost level with the Ground, and requir'd but little uncoping.

As to the Price of scapting Stones.] Some reckon 5 s. the 100 Foot, this they say, is Journey-man's Wages, out of which the Master has but a small Profit; 50 Foot is reckon'd a Days Work, tho' some will do 60 in a Day, superficial Measure; and they reckon only the Face of the Stone, tho' they scapt five Sides to each Stone, *viz.* a Face, two Beds and two Ends, so the *Back* goes rough as it comes out of the Quarry. But in *scapting* (if they can conveniently) they chuse that for the Face of the Stone which will be most for their Advantage.

Of the Measuring of Stone Work.] Masons in some Parts of *Sussex*, have a Custom to measure their Stone Work thus; they apply one End of a Line to the Top of the Copeing, and so carry it along the Slant of the Copeing, and press it under the Tothing (if there be any) and from thence they carry it to the Water or Ground Table (if there be any such in the Wall) where they press it in likewise, and then they carry it over the Table to the Bottom of the Foundation; and this Dimension thus taken, they account for the Height, which multiply'd into the Length, gives the Content.

STORIES. Says *M. Le Clerc* in a publick Place intended for the Magnificence, as well as Convenience of a City, the Buildings

Buildings cannot be too stately : now as nothing carries more State with it, than one grand Order, this is what must be thought on in the first Place : however as Conveniency on this Occasion is to be inseparable from Magnificence, I think two Stories may be allow'd in the Height of this one Order; and if the whole be rais'd on a *Rustic* Order, 'twill be a great Addition to the Beauty of the Ordonnance.

Over this grand Order, one may raise a Ballustrade, to make it terminate more agreeably, and to conceal in some Measure the Roof, which is never found any great Ornament to a beautiful Building.

Instead of Pilasters one might place an Ornament of insulate Columns with a Corridore or Gallery behind; which would be still infinitely better.

STOVE, a hot House or Room.

Palladio observes that the Ancients us'd to warm their Rooms by certain secret Pipes, which came thro' the Walls, conveying Heat to several Parts of the House, from one common Furnace. Whether this were a common Custom, says Sir *Henry Wootton*, or a Curiosity, we cannot determine; but it was certainly both for Profit and Use, far beyond the *German* Use.

STOVE, a Kitchen Term, being a Sort of Furnace, where they dress Pottages, and where they prepare Ragoes. It is made of Brick-Work, furnish'd with Chaffing - Dishes above,

and an Ash-Pan underneath.

STOVES in Gardens, are Contrivances for preserving such tender Exotick Plants, which will not live in our Northern Climates, without artificial Warmth in Winter. These are chiefly of two Sorts, call'd *Dry-Stoves* and *Bark-Stoves*.

A Dry Stove is so contriv'd, that the *Flues* through which the Smoke passes, are either carried under the Pavement of the Floor, or else are erected in the back Part of the House, over each other, like Steps.

This Stove may either be built with upright and sloping Glasses at the Top, in the same Manner as in the Bark-Stove, or else the Front Glasses which should run from the Floor to the Ceiling, may be laid sloping to an Angle of 45 Degrees, the better to admit the Rays of the Sun in *Spring* and *Autumn*.

The latter Method has been chiefly followed by most Persons who have built these Sorts of Stoves; but a very ingenious Author says, that were he to have the Contrivance of a Stove of this Kind, he would have it built after the Model of the Bark-Stove, with upright Glasses in the Front, and sloping Glasses over them, because this will more easily admit the Sun, at all the different Seasons; for in *Summer*, when the Sun is high, the Top Glasses will admit the Rays to shine almost all over the House; and in *Winter*, when the Sun is low, the Front Glas-

ses will admit its Rays ; whereas when the Glasses are laid to any Declivity in one Direction, the Rays of the Sun will not fall directly thereon above a Fortnight in *Autumn* ; and about the same time in the *Spring*, and during the other Parts of the Year, they will fall obliquely thereon ; and in *Summer*, when the Sun is high, the Rays will not reach above five or six Feet from the Glasses.

And so the Plants plac'd towards the back Part of the House, will not thrive in the Summer Season for want of Air, whereas when they are sloping Glasses at the Top, which run within four Feet of the Back of the House, these by being drawn down in hot Weather, will let in perpendicular Air to all the Plants ; and of what Service this is to all the Plants, few are ignorant who have made Observations on the Growth of Plants in a Stove. For when Plants are plac'd under Covert of a Ceiling, they always turn themselves towards the Air and Light, and by that Means deviate from their erect Direction, and grow crooked ; and if you turn them every Week, in Order to preserve their erect Posture, they will nevertheless grow weak, and look pale and sickly.

As to the further Contrivance of this Sort of *Dry Stove*, the Temper of the Place ought to be considered, whether the Situation be dry or wet ; if it be dry, then the Floor need not

be rais'd above two Feet above the level of the Ground ; but if it be wet, let it be rais'd three Feet, because as the Flues are to be carried under the Floor, so when they are made under, or close upon the Surface of the Ground, they will raise a Damp ; neither will they draw so well, as when they are more elevated.

The Furnace of this Stove may be plac'd either at the back Part of the House, or at one End, according as the Convenience of the Building does permit.

This also must be made according to the Fuel intended to be burnt, which if for Coals or Wood, may be made according to the common Method for Coppers, but only much larger, because as the Fire is to be continued in the Night chiefly, so if there is not Room to contain a sufficient Quantity of Fuel, it will require the Trouble of attending the Fire in the Night, which, if neglected, would be of dangerous Consequence to the Plants.

But if the Fuel intended to be burnt, be Turf ; then the Contrivance of the Furnace, may be the same as for the *Bark Stove*.

The Flues of this Stove should be turn'd in Angles, after the following Manner, $\wedge\wedge\wedge\wedge\wedge\wedge$, which will cause them to draw better than if they were strait, and by being dispos'd in this Method, they will reach from the Back to the Front of the House.

They should not be less in Depth

Depth than 18 Inches, and very near the same in Width, which will prevent them from being soon choak'd up with Soot.

The Spaces between the Flues should be fill'd up with either dry Brick, Rubbish, Lime or Sand, from which but little Moisture can arise; and the Flues should be closely plastered with Loam both within and without, and the upper Part of them covered with a coarse Cloth under the Floor, to hinder the Smoke from getting into the House.

When the Flue is carried from the Furnace to the End of the House, it may be return'd in the Back, above the Floor, in a strait Line, which may be contriv'd to appear like a Step or two; by which Means the Smoke will be continued in the House, until all its Heat is spent: which will warm the Air of the House the better.

The Chimneys thro' which the Smoke is to pass, may be either at both Ends, or in the middle, carried up in the Thickness of the Brickwork of the Walls, so as not to appear in Sight.

The Flues should be first cover'd either with Iron Plates or broad Tiles, and then a Bed of Sand over them, about two Inches thick, upon which the plain Tiles should be laid, to correspond with the Rest of the Floor.

This Thickness of Cover will be full enough to hinder the too sudden Rise of the Heat from the Flues.

But if the Furnace is plac'd

under the Floor, the Thickness of Sand between the Iron Plate which covers it and the Floor, ought not to be less than four Inches; wherefore the Bottom of the Furnace ought to be sunk lower; and if the Flues are laid a little rising from the Fire-Place to the End of the House, it will be a Means to make them draw the better; but this Rise must be allow'd in placing them lower under the Floor, next the Fire, because if the Floor be not laid perfectly level, it would appear unsightly.

Bark Stoves are such as have a large Pit, pretty near the Length of the House, three Feet in Depth, and six or seven in Breadth, according as the House is in Breadth.

This Pit is to be fill'd with fresh *Tanner's Bark*, to make a hot Bed, and in this Bed, the Pots of the most tender Exotic Trees and herbacious Plants are to be plung'd.

The Dimension of this Stove should be in Proportion to the Number of Plants that are to be plac'd in it; but as to the Length it should not exceed 40 Feet, except it have two Fire Places, in which Case it would be proper to make a Partition of Glass in the middle, and also two Tan-Pits, that there may be two different Heats for Plants of different Climates, which would be of great Advantage to the Plants, because they may have the Air in each Division shifted, by sliding the Glasses of the Partitions, or by opening the Glass Door,

Door, which should be made between every Division, altho' there should be three or more Divisions in the Range, and this Door would also be an easy Passage from one Division to another.

This *Stove* ought to be rais'd above the Level of the Ground proportionally to the Drieness of the Place, and the whole should be built on the Top of the Ground, if the Situation be moist; so that the Brick-work in Front, must be rais'd three Feet above the Surface, which is the full Depth of the Bark-Bed; by which Means none of the Bark will be in Danger of lying in the Water.

But on the other Hand, if the Soil be dry, the Brick-work in Front, need not be more than one Foot above Ground, and the Pit may be sunk two Feet below the Surface.

Upon the Top of this Brick-work, in Front, must be laid the Plate of Timber, into which the wooden Work of the Frame is to be fastened, and the upright Timbers in Front, should be plac'd four Feet asunder, or somewhat more, which is the Proportion of the Glass Doors or Sashes.

These ought to be about six Feet and a half, or seven Feet in Length, and plac'd upright; but from the Top of these should be sloping Glasses, which should reach within three Feet of the Back of the Stove, where there is to be a strong Crown-Piece of Timber plac'd, in which is to be a Groove

made for the Glasses to slide in.

The Wall in the Back of the Stove, should be a Brick and half thick, and carried up about nine Feet above the Surface of the Bark-Bed: and from the Top of this Wall, there should be a sloping Roof to the Crown Piece in which the Glasses slide.

This Crown Piece should be in Height about 16 Feet from the Surface of the Bark-Bed or Floor, which will give a Declivity to the sloping Glasses, sufficient to carry off the Wet, and be high enough to contain many tall Plants. The back Roof of this, may be either covered with Lead, slated or tiled.

In the Front of the House there ought to be a Walk about a Foot and half or better wide, for the Conveniency of walking, and next to this should the Bark-Bed be plac'd, which should be proportionable in Width to the Breadth of the House: as if the House be 12 Feet wide, the Pit may be 7 Feet wide; behind which there should be a Walk of a Foot and half, for a Passage for watering the Plants in the Pit; and then there will be about 22 Inches vacant next the back Wall, for erecting the Flues, which must all be rais'd above the Top of the Bark-Bed; these Flues ought to be 16 Inches broad in the Clear, that they may not be too soon stopp'd with the Soot; and the lower Flue into which the Smoke first enters from the Fire, should

should be two Feet deep in the Clear, and this may be covered either with cast Iron Plates or broad Tiles; over this the second Flue must be returned back again, which may be a Foot and an half deep, and covered on the Top, as before, and so in like Manner, the Flues may be return'd over each other three or four times, that the Heat may be spent before the Smoke passes off.

The Thickness of the Wall in the Front of these Flues, need not be more than four Inches; but must be well jointed with Mortar, and plastered withinside to hinder the Smoke from getting into the House; and the Outside should be fac'd with Mortar, and cover'd with a coarse Cloth, to keep the Mortar from cracking; as is practis'd in setting up Coppers.

If this be perform'd carefully, there will be no Danger of the Smoke getting into the House, which cannot be too carefully avoided; for nothing is more offensive to Plants than Smoke, which will cause them to drop their Leaves, and if it continue long in the House, will destroy them utterly.

The Fire Place may be made either in the middle, or at one End, according as Conveniency will permit, but wherever it is plac'd, it should have a Shed over it, and not be expos'd to the open Air; for if the Wind has full Ingress to it, it will be impossible to make the Fire burn equally, and it will also be troublesome to attend the Fire in wet Wea-

ther, where it is expos'd to Rain.

The Contrivance of the Furnace, ought to be according to the Fuel intended to be burned in it; but Turf being the best Fireing for Stoves, where it can be had, because it burns more moderately than any other Sort of Fuel, and so requires lesser Attendance, so I shall describe a proper Sort of Furnace for that Purpose.

The whole of this Furnace ought to be erected within the House, which will be a great Addition to the Heat, and the Front Wall on the outside of the Fire Place, next the Shed, ought to be two Bricks thick, the better to prevent the Heat from coming out that Way.

The Door of the Furnace at which the Fuel is put in, must be as small as conveniently may be, to admit of Fuel; and this Door should be plac'd near the upper Part of the Furnace, and made to shut as close as possible, so that but little of the Heat may pass off through it.

This Furnace should be in Depth about 20 Inches, and as much square in the Bottom; but may be slop'd off on every Side, so as to be two Feet square at the Top; and under this Furnace, should be a Place for the Ashes to fall into, in Depth about a Foot, and of the Width of the Bottom of the Furnace.

This should have an Iron Door, to shut as close as possible; but just over the Ash-Hole,

Hole, above the Bars which support the Fuel, should be a square Hole about four Inches wide, to let in Air to make the Fire burn; this must also have an Iron Frame and Door, to shut close, when the Fire is perfectly lighted, which will make the Fuel last the longer, and the Heat will be the more moderate.

The Top of this Furnace ought to be nearly equal to the Top of the Bark-Bed, that the lowest Flue may be above the Fire, so that there may be a greater Draught from the Smoke, and the Furnace must be covered with a large Iron Plate, closely cemented to the Brick work, to prevent the Smoke from getting out.

Also great Care is to be taken, wherever the Fire is plac'd, that it be not too near the Bark-Bed; for the Heat of the Fire will, by its long Continuance, dry the Bark, so that it will lose its Vertue, and be in Danger of taking Fire; to prevent which, it will be the best Way to continue a Hollow between the Brick-work of the Fire and that of the Pit, about the Width of a Foot and a half, which will effectually prevent any Damage that might otherwise happen from the Heat of the Fire.

And no Wood-work must be plac'd any where near the Flues or the Fire Place, because the continual Heat of the Stove may in Time dry it so much as to cause it to take Fire, which cannot be too carefully guarded against.

The Entrance into this Stove should be either from a Green House, the Dry Stove, or else through the Shed, where the Fire is made, because in cold Weather, the Front Glasses must not be opened.

The Inside of the House must be clean white-wash'd, because the whiter the back Part of the House is, the better it will reflect the Light, which is of great Consequence to Plants, especially in *Winter*, when you are oblig'd to keep the Stove clean shut up.

Over the Top-sliding Glasses, there should either be wooden Shutters or Tarpawlines to roll down over them in bad Weather, to prevent the Wet from getting through the Glasses, and also to secure them from being broke by Storms of Hail; and these Outer-Coverings will be serviceable to keep out the Frost.

STRAIT [with *Bricklayers*] a Term us'd for half, or more or less than half of a Tile.

These are ordinarily us'd at the Gable Ends, where they are laid at every other Course, to cause the Tiles to *break Joint* (as they phrase it) that is that the Joints of one (Course) may not answer exactly to the Joints of the next Course either above or below it.

STRAIGHT ARCH. See *Arch*.

STRETCHERS. See *Arch*.

STRUCTURE. See *Building*.

STRIÆ [in the ancient *Architecture*] are the Lists, Fillets

lets or Rays, which separate the Striges or Flutings of Columns.

STRIGES [in the ancient *Architecture*] are what in the Modern we call *Flutings*.

They are thus call'd, as suppos'd to have been originally intended to imitate the Folds or Plaits of Women's Robes; which are by the *Latins* call'd *Striges*.

STUC [in *Masonry*] is a Composition of Lime and Dust of white Marble. pounded together and sifted; of which Figures and other Ornaments in Sculpture are made.

STUFF [with *Joiners*, &c.] the Wood they work on.

STYLOBATÆ, the same as *Pedestals*.

SUB-CONTRARY *Position* [in *Geometry*] is when two similar Triangles are so plac'd as to have one common Angle at their Vertex, and yet their Sides not parallel.

SUBDUCTION [in *Arithmetick*] the same as *Subtraction*.

SUBDUPLERatio, is when any Number or Quantity is contain'd in another twice, thus 3 is said to be a Subduple of 6, as 6 is Duple of 3.

SUBSTRUCTION [in *Building*] See *Foundation*.

SUBTENSE [in *Geometry*] is a Right Line opposite to an Angle, and presum'd to be drawn between the two Extremities of the Arch, which measures that Angle.

SUMMER [in *Architecture*] is a large Stone, the first that is laid over Columns and Pilasters in beginning, to make a

cross Vault; or it is the Stone which being laid over a Piedroit or Column, is hollowed, to receive the first Haunce of a Plat-Band.

SUMMER [in *Carpentry*] is a large Piece of Timber, which being supported on two stout Peers or Posts, serves as a Lintel to a Door, Window, &c.

There are also *Summers* in various Engines, &c. serving to sustain the Weight.

SUMMER-HOUSE, a little Edifice erected at the Corner of a Garden, and contriv'd so as to let in Air on all Sides; or to exclude it, as you find it refreshing or inconvenient, by having Windows or Doors plac'd accordingly.

SUMMER-TREE, a Beam full of Mortoises, for the Ends of Joists to lie in. See *Bress Summers* and *Girders*.

SUMMET } the Vertex or
SUMMIT } Point of any Body, as of a Triangle, a Pyramid, a Pediment, &c.

SUPERCILIUM [in the ancient *Architecture*] the uppermost Member of the Cornice, call'd by the Moderns *Corona*, *Crown* or *Larmier*.

It is also us'd for a square Member under the upper *Tore* of some Pedestals. Some Authors confound it with the *Tore* it self.

SUPERFICIES [in *Geometry*] i. e. Surface, a Magnitude considered as having two Dimensions; or extended in Length and Breadth; but without Thickness or Depth.

In Bodies the *Superficies* is all

all that presents it self to the Eye.

A Superficies is chiefly considered as the external Part of a Solid, when we speak of a Surface simply, and without any Regard to Body, we usually call it Figure.

A *Rectilinear* SUPERFICIES, is that comprehended between Right Lines.

A *Curvilinear* SUPERFICIES, is that comprehended between Curve Lines.

A *Plane* SUPERFICIES is that which has no Inequality, but lies even between its boundary Lines.

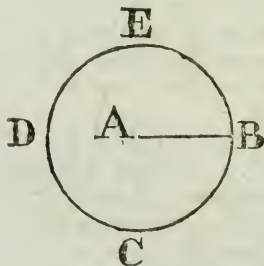
A *Concave* SUPERFICIES is the internal Part of an orbicular Body.

A *Convex* SUPERFICIES is the exterior Part of a spherical Body.

The Measure or Quantity of a Superficies or Surface, is call'd the *Area* of it.

The finding the Measure or Area of a Superficies is call'd the Quadrature of it.

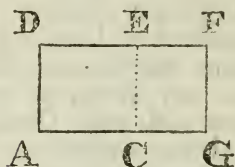
SUPERFICIES is that which hath only Longitude and Latitude, that is Length and Breadth without Depth or Thickness.



As Right Lines are gene-

rated by the Motion of Points so are Superficies by the Motion of Right Lines.

For *First*, If the Right Line A B be fix'd at A, as on a Centre, and the Point B mov'd to C, thence to D, and from thence to E, and lastly to B, it will by its Revolution describe a Superficies, which is call'd a Circle.



2. If the Right Line A D be mov'd along the Line A C, until A C is equal to A D; that is, in the Position C E, it will by its Motion describe a Geometrical Square, A D E C, and if continued on to F G, it will generate the Parallelogram A D F G.

SYMMETRY, The Relation or Equality in the Height, Length and Breadth of the Parts necessary to compose a beautiful Whole.

Vitruvius makes Symmetry to consist in the Union and Conformity of Relation of the Members of a Work to their whole, and of each of the separate Parts to the Beauty of the intire Work; Regard being had to some certain Measure, so that the Body is fram'd with Symmetry by the Relation the Arm, Elbow, Hand, Fingers, &c. have to each other, and to their Whole.

SYMMETRY [in *Architecture*]

ecture] is call'd *uniform Symmetry*, and is that where Ordinance reigns in the same Manner throughout the whole Pourtour.

Respective SYMMETRY is that wherein the opposite Sides are equal to each other.

T

TABERN, a Cellar.

TABLE [in *Architecture*] is a smooth simple Member or Ornament of various Forms; but most usually in that of a long Square.

A *Projecting Table*, is that which stands out from the Naked of the Wall, Pedestal, or other Matter it adorns.

Raked Table, is that which is hollow'd in the Die of a Pedestal, or elsewhere, as is usually encompass'd with a Moulding.

Razed Table is an Imbossment in a Frontispiece for the putting an Inscription or other Ornament in Sculpture. This is what M. *Perrault* understands by *Abacus* in *Vitruvius*.

Crown'd Table, that which is cover'd with a Cornice, and in which a *Basso Relievo* is cut, or a Piece of black Marble incrustated for an Inscription.

Rusticated Table, that which is pick'd, and whose Surface seems rough, as in Grotto's, &c.

TABLE [in *Perspective*] is a Plain Surface suppos'd to be transparent, and perpendicular to the Horizon.

It is always imagin'd to be plac'd at a certain Distance be-

tween the Eye and the Objects, for the Objects to be represented thereon, by Means of the visual Rays passing from every Point thereof, thro' the Table to the Eye, whence it is call'd a *Perspective Plane*.

TABLE of *Glass*, See *Case of Glass*.

TABLES or **PANNELS**.

The Tables in the Die of the Pedestal, ought to be equal to the Width of the Column; that is two Modules: now the Width of the Die being two Modules, says M. *Le Clerc*, 24 Minutes, there remains 12 Minutes for the Width of the List that goes round it; tho' towards the Bottom it must be somewhat wider, and may be pretty well fix'd at 15 Minutes.

When these Tables are of Marble, he chuses rather to have them fix'd even with the Die. However, if they are to be sunk lower, the Inequality ought not ordinarily to exceed a Minute and a half; in which Case they should have a *Baguette*, or a little *Talon* or *Cavetto* for a Border.

In these Tables are sometimes added *Basso Relievo's* which may be of Marble, of Brass, or even of Brass gilt: but special Care must be taken that the Relievo never project beyond the Naked of the Die.

The Sculptor therefore, in this Case, must take a sufficient Depth for the Ground of this Work, and the Work it self must be rais'd as little as possible.

Some Architects bound these

Tables with a little Border, projecting beyond the Naked of the Die; but *M. Le Clerc* is of Opinion, that they ought not to be imitated herein, such a projecting Moulding or Frame agreeing very ill with the Astragal above it, and which it self projects nearly as much, as the Baguette that terminates the Bottom of the Corniche.

To which it may be added, that so many little Mouldings being found, almost at an equal Distance from one another, have an ill Effect; for it must be remembred, that the beautiful Distribution of Mouldings, consists in observing a Diversity in their Bignesses, Figures and Distances.

TACKS. See *Nails*.

TAILLOIR [in *Architecture*] a Term us'd by some Writers, in Imitation of the *French*, for *Abacus*.

TALON [in *Architecture*] a Kind of Astragal or Moulding, consisting of a square Fillet, crowning a Cymatium, frequently found to terminate Ornaments of Joiners Work, as those of Doors, &c.

TALON. *M. Le Clerc* says, that when a little *Talon* or *Gula* serves as a *Cymaise*, particularly when it terminates an Impost, or when it terminates the Cornice of the Pedestals, He gives it a Fillet something stronger than what he uses to do, when it is found inclos'd between other Mouldings.

He makes the Fillet of the first the stronger, because being more expos'd, it is more liable to be broken; besides,

that these last Mouldings always appear more delicate than really they are, by Reason of the Air, which seems to take something off from their Bulk.

The Height of this Fillet, is half that of the Talon, and that of the Second, only a third.

TALUS ? [in *Architecture*]

TALUT } the sensible Inclination or Slope of a Work; as of the Outside of a Wall, when its Thickness is diminish'd by Degrees, as it rises in Height, to make it the firmer.

TAMBOUR [in *Architecture*] is a Term apply'd to the *Corinthian* and *Composite* Capitals; as bearing some Resemblance to a Drum, which *Tambour* signifies in *French*.

Some call it Vase, and others the Campana or Bell.

TAMBOUR is also us'd to signify a little Box of Timber Work, cover'd with a Ceiling on the Inside the Porch of certain Churches; both to prevent the View of Persons passing by, and to keep off the Wind by the Means of folding Doors.

TAMBOUR is also us'd for a round Stone, or Course of Stones, several of which serve for a Section of the Shaft of a Column.

TANGENT [in *Geometry*] is a Right Line, which touches a Circle which meets it in such a Manner, as that tho' it were infinitely produc'd, it would never cut the same; that is, never come within the Circumference of it: thus the Line A D, is a Tangent to the Circle in D. See *Plate, Fig. 1.*

'Tis demonstrated in the Figure,

gure, that if the Tangent A D, and a Secant A B, be both drawn from the same Point A, the Square of the Tangent will be equal to the Rectangle, under the whole Secant A B, and that Portion thereof A C, will fall without the Circle.

2. That if two Tangents, A D, A E, be drawn to the same Circle, from the same Point A, they will be equal to each other.

TANGENT [in *Trigonometry*] a Tangent of an Arch is a Right-Line, rais'd perpendicularly on the Extreme of the Diameter, and continued to a Point, where it is cut by a Secant; that is, by a Line drawn from the Centre, through the Extremity of the Arch whereof it is a *Tangent*.

Or thus, a *Tangent* of an Arch E A, is a Part of a Tangent of a Circle (that is, of a Right-Line which touches a Circle without cutting it) intercepted between two Right-Lines drawn from the Centre C through the Extremes of the Arch E and A. See *Plate, Fig. 2.*

TAPER } [in *Joinery*,
TAPERING } &c.] is understood of a Piece of Board, Timber, or the like, when it is broad beneath, and sharp towards the Top, or diminishing gradually from the biggest End.

TARRASS } a Sort of Pla-
TERRASS } ster, or strong Mortar, chiefly us'd in lining Basons, Cisterns, Wells, and other Reservoirs of Water.

TARRASS } [in *Architec-*
TERRAS } ture] an o-

pen Walk or Gallery; also a flat Roof of an House.

TASSELS [in *Building*] are Pieces of Board that lie under the Mantle-Tree.

TEETH. See *Dentils*.

TEMPLE [in *Architecture*] The ancient Temples were distinguish'd in Respect to their Construction into various Kinds, as,

TEMPLES of *Antæ*, or single *Antæ*; these, according to *Vitruvius*, were the most simple of all Temples; having only angular Pilasters, call'd *Antæ* or *Parastatæ*, at the Corners, and two *Tuscan* Columns on each Side the Doors.

Tetrastyle **TEMPLE** or singly **TETRASTYLE**; was a Temple which had four Columns in the Front, and as many behind; as that of *Fortuna Virilis* at *Rome*.

Prostyle **TEMPLE**, is one which had Columns only in the Front or Fore-side, as that of *Ceres*, at *Eleusis* in *Greece*.

Amphi-Prostyle **TEMPLE**, i. e. Double *Prostyle*, was one that had Columns both before and behind, and which was also call'd *Tetrastyle*.

Periptere **TEMPLE**, one which had four Rows of insulated Columns around, and was also *Hexastyle*. i. e. had six Columns in Front; as the Temple of *Honour* at *Rome*.

Diptere **TEMPLE**, is one which had eight Rows of Columns around, and was also *Octostyle*; or had eight Columns in Front, as that of *Diana* at *Ephesus*.

TENON } [in *Carpentry*,
 TENNON } &c.] is the
 End of a Piece of Wood, di-
 minish'd by one third of its
 Thickness, to be receiv'd into
 a Hole in another Piece, call'd
 a *Mortoise*, for the jointing or
 fastening the two together.

It is made in various Forms;
 square, dove-tail'd for double
 Mortoises, and the like.

TENIA. See *Tania* and
Lift.

TERM [in *Geometry*] some-
 times signifies a Point, some-
 times a Line, &c. a Line is
 the Term of a Superficies, and
 a Superficies of a Solid.

TERM } [in *Architec-*
 TERMINUS } *ture*] is
 a Sort of Statue or Column,
 adorn'd at the Top with the
 Figure of the Head of a Man,
 a Woman, or Satyr, as the Ca-
 pital, and the lower Part end-
 ing in a kind of Sheath or
 Scabbard.

These *Terms* are sometimes
 us'd as Consoles, and sustain
 Entablatures; and sometimes
 as Statues to adorn Gardens.

Some call these *Thermes*,
 and derive the Name from
Hermes, a Name given by the
Greeks to the God *Mercury*,
 whose Statue made after this
 Manner, was plac'd in several
 Cross-Ways in the City of
Athens.

Others derive the Name
 from the *Roman* Deity *Termin-*
us, who was accounted by
 them the Protector of Land-
 Marks.

Whose Statue (made with-
 out Hands and Feet, that he
 might not change his Place)

was usually planted at the
 Bounds of Land, to separate
 them.

Of these *Termin's* the An-
 cients made great Variety, viz.
Angelick, Rustic, Marine, Dou-
ble, in Bust, &c.

Milliary TERMS, among
 the ancient *Greeks*; were Heads
 of certain Divinities, plac'd on
 square Land-Marks of Stone,
 or on a Kind of Sheath, to
 mark the several *Stadia, &c.* in
 the Roads.

They were usually dedicated
 to *Mercury*, whom the *Greeks*
 believ'd to preside over High-
 ways. Some of them were
 represented with four Heads;
 such as are still to be seen in
Rome, at the End of the *Fa-*
brician Bridge, thence call'd
Ponte de quatre Capi.

To give them a Figure pro-
 per to represent a delicate Co-
 lumn, their Arms are lop'd
 off, and their Body does not
 appear below the Girdle; these
Terms are very proper in the
 Decorations of a Theatre, as
 also in Pieces of Architecture,
de Creillage (as it is call'd by
M. Le Clerc,) i. e. crail'd work
 Kind.

These *Terms* or *Termini*
 have this in common with the
Caryates (or *Cariatic* Columns)
 that they should never be
 brought to match with the com-
 mon Columns: this Advantage
 however they have in particu-
 lar, that you may give them
 what Degree of Delicacy you
 please, by lengthening out
 their Sheath, and raising the
 Figures to any Height that you
 would have.

By this Means they may be made to suit gay, airy Arches, such as Cabinets, Salloons and Arbours, which are requir'd especially in crailed Work.

M. *Le Clerc* adds, that in his Opinion, it is not reasonable to reduce the Figures of Angels into *Termini*; tho' we see it has been formerly done in Places of Distinction.

TERRACE? a Bank of

TERRASS } Earth, rais'd in a Garden, Court, &c. above the Level of the Ground.

The *Terrace* is a Breast-Work, usually lin'd and breasted with a strong Wall; in Compliance with the natural Inequality of the Ground.

Sometimes it is made in *Talus*, or aslope, and cover'd with Turf.

Counter TERRACE, is a Terrace rais'd over another, for the joining of the Ground, or the raising a Parterre.

TERRACE [in *Building*] is us'd to signify the Roofs of Houses which are flat, and may be walk'd upon; as also Balconies, which project.

The *Terrace* is properly the Covering of a Building which is in Platform; as that of the *Perystile* of the *Louvre*; or that of the Observatory, pay'd with Flint and Mortar.

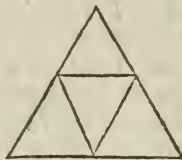
All the Buildings of the Eastern Nations are covered with Terrasses, to take the fresh Air on, and even to lie on.

TESSELATED *Pavement*, is a rich Pavement of Mosaic Work, made of curious small square Marbles, Bricks or Tiles, call'd *Tessellæ*, from the Form of Tiles,

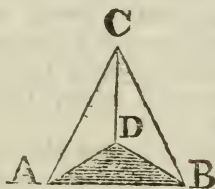
TETRACTYS [in the ancient *Geometry*] the *Pythagoric Tetractys* is a Point, a Line, a Surface and a Solid.

TETRADORON. See *Brick*.

TETRAEDRON } [in
TETRAHEDRON } *Geometry*] is one of the five Regular or Platonic Bodies or Solids; comprehended under four equilateral and equal Angles.



The *Tetraedron* may be conceiv'd as a triangular Pyramid of four equal Faces, as in the Figure.



'Tis demonstrated by Mathematicians, that the Square of the Side of a *Tetraedron* is to the Square of the Diameter of a Sphere, wherein it may be inscrib'd in a subsesquialteral Ratio: whence it follows, that the Side of a *Tetraedron* is to the Diameter of a Sphere it is inscrib'd in, as $\sqrt{2}$ to the $\sqrt{3}$, consequently they are incommensurable.

TETRAGON [in *Geometry*] is a Quadrangle, or a Figure

gure with four Angles: thus a *Square*, *Parallelogram*, *Rhombus*, and *Trapezium*, are tetragonal Figures.

TETRAGONISM, is us'd by some to signify the Quadrature of a Circle.

TETRASTYLE [in the ancient *Architecture*] was a Building, and particularly a Temple, having four Columns, both before and behind, *i. e.* in Front and Rear.

THACK TILES. See *Tiles*.

THATCHING, is the Covering the Roof of a House or Barn, with Straw or Reeds.

1. *With Straw*] *Thatch* (says Mr. *Worlidge*,) is a common Covering in many Places, yet in some to be prefer'd before other some; and that the best that he has seen, is that which is call'd *Helin*, *i. e.* long and stiff Wheat Straw (with the Ears cut off) bound up in Bundles unbruise'd; which if well laid, lies thin, lasts long, and is much neater than the common way.

There is commonly allow'd two good Load of Straw for five Square of Thatching, or one Load to $2\frac{1}{2}$ Square.

Some are said to have pretended that they could thatch a Roof, so that no Mouse could get in; but I know no Instance of any such Thing to have been done.

In some Parts of *Kent*, they don't use *Withs* to bind on their thatching Rods, but instead of that, use *Rope-Yarn*, (as they call it) which is a single stranded Line, about the Size of a Penny Cord; pitched with Pitch,

after the same Manner as some do their Well Ropes.

This costs about 2 *d.* per Pound, a Pound of which will do a Square of Thatching. This, some say, is more durable than *Withs*; for that *Withs* when they are grown Sear, will fly and break, but this will not.

2. *Thatching with Reeds.*]

This Kind of Thatching is said to last 40, 50 or 60 Years.

These Reeds in *Suffex* and *Kent*, are sold by the Thousand, *viz.* a 1000 Handfuls, each Handful being 8, 9 or 10 Inches in Circumference, bound up in a little Band, 1000 of which will cost 15 or 16 *s.* and will cover about three Square of Roofing. For laying of which they have 4 *s.* per Square.

The Price of Thatching.]

Common *Thatching* is done in some Places for 2 *s.* 6 *d.* per Square; but in others they have 2 *s.* 8 *d.* and in others 3 *s.* and for *Thatching* with Reeds, 4 *s.*

Of measuring Thatching.]

Thatching is measured as *Tiling*, *i. e.* by the Square; and in some Places they are allow'd so many Feet more, as the Corners and Gables are Feet in Length. In other Places they are allow'd only so many half Feet more to the whole, as the Gables Ends are Feet in Length; the Reason they give for this Custom, is, because they have more Trouble in turning the Straw (at the Gable) that it may be cut as it is at the Eaves.

If one Side of a Roof only be

be thatch'd, and not the other, they (then) take their Dimensions over the Ridging, as far as the new Straw goes.

THEATRE } a publick E-
THEATER } difice, for
the exhibiting of Spectacles or
Shews to the People.

These comprehended not only the Eminence whereon the Actors appear'd, and the Action pass'd; but also the whole Area or Extent of the Place, common to the Actors and Spectators.

In this Sense, the Theatre was a Building, encompass'd with Portico's, and furnish'd with Seats of Stone, dispos'd in a Semi-Circle, and ascending by Degrees over one another, which encompass'd a Space, call'd the *Orchestra*, in the Front of which was the *Proscenium* or *Pulpitum*, on which the Actors perform'd, and which is what is by us properly call'd the *Theatre* or *Stage*.

On the *Proscenium* stood the *Scena*, a large Front, adorn'd with Orders of Architecture, behind which was the *Postscenium* or Place, where the Actors made themselves ready, retir'd, &c. so that the *Scena* in its full Extent comprehended all the Part belonging to the Actors.

The most celebrated Theatres of Antiquity remaining, are that of *Marcellus*, and of *Pompey*, which are call'd Amphitheatres.

THEATER } [among the
THEATRE } *Moderns*] is
the Stage or Place whereon the

Drama or Play is exhibited, which answers to the Scene of the Ancients.

And in its largest Sense, includes the whole Play-House, *i. e.* a spacious Hall or Room; part of which is taken up by the *Scena*, which includes the Stage, the Decorations and Machines of the Stage; and the Remainder Part, which is distributed into a Space call'd the Pit, which is covered with Seats, Boxes, &c. and an Elevation of one or two Galleries, dispos'd into Benches, rising or ascending one above another.

THEATRE [in *Architecture*] is chiefly us'd by the *Italians* for an Assemblage of several Buildings, which by a happy Disposition and Elevation, represents an agreeable Scene to the Eye.

As that of the Vineyards at *Rome*; that particularly of *Monte Dragone* in *Frescati*, and the new Castle of *St. Germain en Lay* in *France*.

THEODOLYTE, an Instrument us'd in Surveying and taking Heights and Distances.

THEOREM, is a Speculative Proposition, demonstrating the Properties of any Subject.

THEOREM [with *Mathematicians*] signifies a Proposition, which terminates in Theory; and which considers the Properties of Things already made or done. Or it is a Theoretical Proposition, which is deduc'd from several Definitions compar'd together.

Thus if a Triangle be compar'd with a Parallelogram, standing on the same Base, and

of the same Altitude; and partly from their immediate Definitions, and partly from other of their Properties already determin'd, 'tis inferr'd that the Parallelogram is double the Triangle; that Proposition is a Theorem.

There are two Things in every Theorem chiefly to be regarded, viz. the Proposition and the Demonstration. In the first is express'd what agrees to some certain Thing, under certain Conditions, and what does not.

In the latter, the Reasons are laid down, by which the Understanding comes to conceive, that it either does or does not agree thereto.

Theorems are of various Kinds: *Universal Theorems*, are those which extend to any Quantity, without Restriction, universally, as this, that *the Rectangle of the Sizes and Difference of any two Quantities is equal to the Difference of their Squares*.

Particular Theorems, are such as extend only to a particular Quantity.

Negative Theorems, are such as express the Impossibility of any Assertion; as that *the Sum of any two biquadrate Numbers cannot make a Square*.

Local Theorems are such as relate to a Surface; as that *Triangles of the same Base and Altitude, are equal*.

Plane Theorems are such as either relate to a Rectilinear Surface, or to one terminated by the Circumference of a Circle; as that *all Angles in the*

same Segment are equal.

Solid Theorems are those which consider a Space terminated by a Solid Line, i. e. by any of the three Conic Sections; ex. gr. *this; that if a Right Line cut two Asymptotick Parabola's, it's two Parts terminated by them, shall be equal*.

Reciprocal Theorems are those whose Converse is true; as that *if a Triangle have two equal Sides, it must have two equal Angles*, the Converse of which is true, *that if it has two equal Angles, it must have two equal Sides*.

THEORETICK } Relat-
THEORETICAL } ing to
THEORICK } The-
ory, or terminating in Speculation; in which Sense the Words stands in Opposition to Practical.

THIMBLES. See Iron.

THIRD POINT } [in
TIERCE POINT } Archi-
tecture] is the Point of Section in the Vertex of an equilateral Triangle.

Arches or Vaults of the third Point, which the *Italians* call *de terzo acuto*, are such as consist of two Arches of a Circle, meeting in an Angle at the Top.

THOROUGH Framing. See Framing.

THOROUGH lighted. Rooms are said to be thorough lighted, when they have Windows at both Ends.

THROAT [in Architecture.] See Gorge and Gula.

TIGE [in Architecture] is a Term us'd by the French for the

the Shaft or Fust of a Column; comprehended between the Astragal and the Capital.

TILES [in *Building*] are a Sort of thin, factitious or artificial Stones, [of a laminated Figure] us'd in the Roofs of Houses, &c.; but more properly they are a kind of fat clayey Earth, knodden and moulded together, of a just Thickness, dry'd and burnt in a Kiln, like a Brick, and us'd in the Covering of Houses, &c.

Mr. *Leybourn* says, that *Tiles* are made of better Earth than Brick Earth, and something nearer a-kin to Potters Earth.

According to the Statute 17 of *Edw.* IV. the Earth for *Tiles* should be cast up before the 1st of *November*, shired and turned before the 1st of *February*, and not made into *Tiles* before the 1st of *March*; and ought to be try'd and sever'd from Stones, Marl and Chalk.

There are various kinds of *Tiles*, for the various Uses in Building, and those known by several Names, as *Plain, Thack, Ridge, Roof, Crease, Gutter, Pan, Crooked, Flemish, Corner, Hip, Dorman, Dormar, Scallop, Astragal, Traverse, Paving* and *Dutch Tiles*.

Plain or Thack Tiles are those in common Use for the Covering of Houses: they are of an oblong Figure, being squeez'd flat, while they are soft.

As to their Dimensions] By the Stat. 13 of *Edw.* IV. are to be 10 $\frac{1}{2}$ Inches long, 6 broad, and half an Inch and half a

quarter thick at least; but these Dimensions are not strictly kept to.

But in *Suffex*, a certain Author tells us, he finds them to be of different Dimensions; some 10 Inches long, 6 $\frac{3}{4}$ broad, and $\frac{2}{3}$ of an Inch thick; others but 9 $\frac{1}{2}$ Inches long, 5 $\frac{3}{4}$ broad, and about $\frac{1}{2}$ an Inch thick.

As to the Weight.] Mr. *Leybourn* says, that one plain *Tile* weighs about two Pounds and $\frac{1}{2}$; whence 100 of them will weigh about 250 *l.* and 1000 of them, 2500 *l.*

But others say, they have found that a single *Tile* of 10 Inches long, has not weigh'd above 2 *l.* 3 Ounces, so that 100 of them, will not weigh but 220 *l.* and 1000, 2200 *l.* and one of the other Size, weigh'd about two Pounds; so that 100 of them, will weigh but 200 *l.* and 1000, 2000 *l.*

As to their Price,] they are in some Places dearer, and in some cheaper, according to the Scarcity and Plenty of Earth of which they are made, and of the Wood with which they are burnt.

Mr. *Wing* tells us, that they are from 25 to 30 *s.* per 1000 in *Rutlandshire*; and Mr. *Leybourn* says, 25 *s.* in *London*; but in *Suffex*, they are sold from 15 to 17 *s.* the 1000.

Ridge Tiles } are those us'd
Roof Tiles } for Covering
Crease Tiles } the Ridges of Houses, being made Circular Breadth-wise, like a half Cylinder.

The Dimensions.] These according to the aforesaid Statute

tute, are to be 13 Inches long, and of the same Thickness with *Plain Tiles*.

But some of them have been found to be 13 Inches long, and 16 broad, by Compass on the Outside, and in Breadth (from Side to Side) on the Inside about 11 Inches, and some not above 9 or 10 Inches.

As to their Weight.] Some of them have been found to weigh about 8 l. $\frac{3}{4}$, so that 100 of them will weigh 875 l. and 1000, 8750 l.

Their Price.] Mr. *Leybourn* says, five, six, or seven of these *Tiles*, are allow'd into every 1000 of *Plain Tiles*; but if bought by themselves, they are sold from 20 to 25 s. per Hundred, and in *Suffex*, at 2 d. per Piece, or else 16 s. per Hundred.

Hip or Corner Tiles are such as lye on the Hips or Corners of Roofs. As to their Form, they are at first made flat like *Plain Tiles*; but of a Quadrangular Figure, whose two Sides are Right Lines; and two Ends, Arches of Circles, one End being a little Concave, and the other Convex; the Convex End to be about seven times as broad as the Concave End; so that they would be triangular, but that one Corner is taken off; then before they are burnt, they are bent on a Mould, Breadth-wise, like *Ridge Tiles*: They have a Hole at their narrow End, and are laid and nail'd with their narrow End upwards.

Their Dimensions.] By the Statute above-mention'd, these

Tiles ought to be 10 Inches $\frac{1}{4}$ long, with convenient Breadth and Thickness. But some who have measured them, say they have found them to be 10 Inches in Breadth (according to their Compass) at the narrow End two Inches, and at the broad End, 14 Inches; and the Right-lin'd Breadth, at the broad End, about 11 Inches.

As to their Weight.] One of these *Tiles* has been found to weigh about three Pounds, and three or four Ounces.

As to their Price.] Mr. *Leybourn* says they are usually sold at 1 $\frac{1}{2}$ d. or 2 d. per *Tile*, or from 10 to 15 s. per Hundred. In *Suffex* they are sold for 1 $\frac{1}{2}$ d. per Piece, and 12 s. per Hundred.

Gutter Tiles are those which lie in Gutters or Valleys, in Cross-Buildings. They are made like *Corner Tiles*, only the Corners of the broad End are turned back again with two Wings. They have no Holes in them; but are laid the broad End upwards, without any nailing. They are made in the same Mould with *Corner Tiles*; and have the same Dimensions on the out (or Convex) Side. Their Wings are each four Inches broad, and eight long, pointing out short of their narrow End about two Inches.

Their Weight.] These by the Statute are of the same Weight with *Corner Tiles*; so that 100 of either of these kinds of *Tiles*, will weigh about 321 or 322 Pounds; and 1000 of them will weigh 3210, or 3220 Pounds. *Their*

Their Price.] These are of the same Price with *Corner Tiles*. Holes for the Pins at that End, where the broad End of the triangular Piece stands.

Pan Tiles } are us'd in
Crooked Tiles } covering of
Flemish Tiles } Sheds, Leanto's, and all kinds of flat-rooff'd Buildings. They are in the Form of an oblong Parallelogram, as *Plain Tiles*, but are bent Breadth-wise, forwards and backwards in Form of an S, only one of the Arches is at least three times as big as the other, which biggest Arch is always laid uppermost; and the lesser Arch of another *Tile* lies over the Edge of the great Arch of the former.

They have no Holes for Pins, but hang on the Laths by a Knot of their own Earth.

As to their Dimensions,] they are usually 14 Inches and $\frac{1}{2}$ long, and $10\frac{1}{2}$ broad.

Their Price in most Places is about 7 or 8 s. the Hundred.

Dormer } These *Tiles* con-

Dormer } sist of a *Plain Tile*, and a triangular Piece of a *Plain Tile*, standing up at Right Angles to one Side of the *Plain Tile*, and swept with an Arch of a Circle from the other End, which End terminates in a Point, or has no Breadth.

Of these Kind of *Tiles* there are two Sorts; for in some the triangular Piece stands on the Right, and in others, on the Left Side of the *Plain Tile*; and of each of these again, there are two Kinds; some having a whole *Plain Tile*; others but half a *Plain Tile*: but in them all, the *Plain Tile* has two

Their Use.] They are laid in the Gutters between the Roof and the Cheeks or Sides of the Dormers; the *Plain Tile* Part lying upon the Roof, and the triangular Part, standing perpendicularly by the Cheek of the Dormer.

They are excellent for keeping out the Wet in those Places, and yet not perhaps known any where but in *Sussex*.

As to their Dimensions] The Dimensions of the *Plain Tile* Part, are the same with those of a *Plain Tile*, and the triangular Part is of the same Length, and its Breadth, at one End seven Inches, and at the other, nothing.

Their Weight.] One of these *Tiles* is found to weigh about $4\frac{1}{2}$ Pounds, whence 100 of them will weigh 450 Pounds, and 1000 of them, 4500 Pounds.

Their Price.] They are usually sold at $1\frac{1}{2}d.$ or $2d.$ per Piece, or 12 or 16 s. per 100.

Scallop Tiles } are in all
Astragal Tiles } Respects like *Plain Tiles*, only their lowers Ends are in Form of an *Astragal*: viz. a Semi-Circle with a Square on each Side. They are us'd in some Places for Weather Tilcing, and look very handsome.

Traverse Tiles; are a Sort of irregular *Plain Tiles*, having the Pin-Holes broken out, or one of the lower Corners broken off. These are laid with the broken Ends upwards, upon

Rafters, where pinn'd *Tiles* cannot hang.

Paving-Tiles. These are by some call'd *Paving Bricks*. See *Bricks*.

Flemish Tiles } are of two
Dutch Tiles } Sorts, ancient and modern. The ancient *Dutch Tiles* were us'd for Chimney Foot Paces; they were painted with Antick Figures, and frequently with Postures of Soldiers, sometimes with Compartments, and sometimes with Moresque Devices; but fell far short, both as to the Design, and the Colours of the Modern ones.

The Modern *Flemish Tiles* are commonly us'd plaster'd up in the Jaumbs of Chimneys, instead of Chimney Corner-Stones. These *Tiles* are better glaz'd, and such as are painted (for some are only white) are done with more curious Figures, and more lively Colours than the ancient ones.

But both these Sorts seem to be made of the same whitish Clay, as our white glaz'd Earthen Ware; the modern ones are commonly painted with Birds, Flowers, &c. and sometimes with Histories out of the *New Testament*.

Their Dimensions.] The ancient ones are five Inches $\frac{1}{3}$ square, and about $\frac{3}{4}$ of an Inch thick. The Modern *Flemish Tiles* are $6\frac{1}{2}$ Inches square, and $\frac{3}{4}$ of an Inch thick.

As to their Weight.] The ancient Sort weigh $1\frac{1}{4}$ of a Pound, whence 100 of them will weigh 125 Pounds, and 1000, 1250 Pounds.

The modern ones weigh about one Pounds, three Ounces; whence 100 will weigh 169 Pounds, and 1000, 1690 Pounds.

The Price of making and burning Tiles] according to Mr. *Leybourn* is usually 2 s. or 2 s. 6 d. per 1000; but some Workmen say, that for Casting the Clay, Shiring it and making it into *Tiles* and burning the *Tiles*, they have 6 s. per Thousand.

How many Tiles will cover a Square.] This varies according to the different Width they give for the Laths.

At $6\frac{1}{2}$ Inches Gage, 740 *Tiles* will cover a Square.

At 7 Inch Gage, 690; at $7\frac{1}{2}$ Inch Gage, 640, and at 8 Inch Gage, 600 *Tiles* will cover a Square, or 100 Superficial Feet.

These Numbers, suppose the Breadth of the *Tiles* to be six Inches; for (if they are Statute *Tiles*) they will be thereabout when they are burnt, allowing $\frac{1}{4}$ of an Inch for their shrinking in burning.

If the *Tiles* are broader than six Inches, then a less Number will cover a Square; but if they are narrower, there must be more of them.

TILEING.

By *Tileing* is meant the Covering of a Roof of a Building with *Tiles*.

TILEING is measured by the Square of 10 Feet, as *Flooring*, *Partitioning* and *Roofing* were in the Carpenters Work; so that there will not be much

Diffe-

Difference between Roofing and Tileing. For Bricklayers sometimes will require to have double Measure for Hips and Vallies.

When Gutters are allow'd double Measure, the Way is to measure the Length along the Ridge-Tile, and by that Means the Measure of the Gutters becomes double; it is also usual to allow double Measure at

the Eaves, so much as the Projection is over the Plate, which is commonly about 18 or 20 Inches.

Example 1. There is a Roof cover'd with Tiles, whose Depth on both Sides (with the usual Allowance at the Eaves) is 37 Feet, 3 Inches, and the Length 45 Feet; how many Squares of Tileing are contain'd in it?

F.	I.
37	3
45	0
<hr/>	
185	
148	
11	3
<hr/>	
16 76	3

37.25
45
<hr/>
18625
14900
<hr/>

16 76.25

Answer, 16 Squares, 76 Feet.

Example 2. There is a Roof cover'd with Tiles whose Depth on both Sides (with the Allowance at the Eaves is 35 Feet,

9 Inches, and the Length 43 Feet, 6 Inches. How many Squares of Tileing are in the Roof?

F.	I.
43	6
35	9
<hr/>	
215	
129	
21	
10	10
17	6
<hr/>	
15 15	1 6

35.75
43 5
<hr/>
71875
10725
14300
<hr/>

15 55.125

Here the Length and Depth being multiply'd together, the Product is 1555 Feet; which

By Scale and Compaffes.

In the first Example, extend the Compaffes from 1 to 37.25, and that Extent will reach from 45 to 16 Square, and a little above three quarters of a Square.

In the second Example, extend the Compaffes from 1 to 35.75, and that Extent will reach from 43.5, to 15 Squares and 55 Feet.

The Price of Tileing.] Tileing in new Work (Mr. *Leybourn* fays) and the Workman finding all Materials, as Tiles, Mortar, Laths and Nails, is ufually valued at 30 s. or 32 s. *per* Square.

Mr. *Hatton* reckons but 28 s. *per* Square.

And for ripping of old Work, and new covering and making good the old, they reckon 12 or 14 s. the Square, according as they find the old Tileing.

But for Workmanship only, they reckon at *London*, 5 s. *per* Square; but in the Country, the Price is various.

Mr. *Wing* fays, 3 s. in *Rutland*, and in fome Places 2 s. 6d.

In *Suffex* it is ufually done for 3 s. *per* Square, and fome fay that it is done for 2 s. 6d. in fome Parts of *Kent*; but then their Tiles are large, and they Lath wide at eight Inch Gages, and pin but half their Tiles, they laying the other half traverse.

And for ripping and healing again (only) Workmanship, *Suffex* Bricklayers reckon 3 s. 6d. *per* Square; and if they Counter-lath it, then 3 s. 9d. or 4 s.

But in fome Parts of *Kent* they Rip and Heal and Counter-lath for 3 s. *per* Square, which is very cheap, but then it is fuppos'd they do their Work accordingly.

What Number of Laths and Nails go to a Square of Tileing] See the Articles *Laths* and *Nails*.

The Mortar that is us'd in a Square of Tileing.] The Quantity is $\frac{1}{4}$ of as much Mortar as is allow'd to a Rod of *Brick-work*, will do for a Square of Tileing.

The Number of Pins to a Square.] Mr. *Leybourn* fays, they ufually allow a Peck of Tile Pins (from 2 s. 4d. the Bushel) to every 1000 of Tiles; yet fome fay they use but about a Peck to three Square of Healing, which at 7 Inch Gage is more than enough for 2000 Tiles.

To lay Tiles without Mortar, &c. i. e. laying them dry, as they come from the Kiln.

Some lay them in a Sort of Mortar, made with Loam and Horfe-Dung.

In fome Parts of *Kent*, they have a Way of laying Tiles in *Moss*, which when the Workmen get themselves, they are allow'd 2d. in a Square the more for their Work.

Some do not approve of this Way of Tileing with *Moss*; becaufe, they fay, that in windy, wet Weather, when the Rain, Snow or Sleet is driven under the Tiles (in the *Moss*) if there follows a Frost, while the *Moss* is wet, it then freezes and raifes the Tiles out of their Places.

Tile-

Tileing with Pan - Tiles.] These Tiles are for the most Part laid dry, without Mortar, yet sometimes pointed within-side.

The Laths on which they hang, are 10 or 12 Feet in Length, and about an Inch and half in Breadth.

They are usually sold at 2 *d.* or 3 *d.* the Lath, or at 10 or 13 *s.* the Hundred.

The Gage for nailing on

these Laths (with 4 *d.* Nails) is 10 Inches and a half, and the Breadth of a Tile when laid, is eight Inches; so that about 170 will cover a Square (or 100 Foot) of this Kind of Tileing.

A great Covering with these spends but little Mortar (if pointed) and but little Time in laying.

Mr. *Wing* reckons it worth 1 *s.* 8 *d.* per Square laying.

A TABLE, Shewing the Price or Value of any Number of odd Feet of Tileing, Slateing, Roofing, Flooring, &c. which is done by the Square of ten Foot, from one Foot to twenty five, or quarter of a Square; and at any Price, from Two Shillings and Six-pence, to five Pound the Square.

		s.	d.	s.	d.	s.	d.	s.	d.
The Price of	Square			6	0	7	0	8	0
	$\frac{3}{4}$ Square	3	9	4	6	5	3	6	0
	$\frac{1}{2}$ Square	2	6	3	0	3	6	4	0
	$\frac{1}{4}$ Square	1	3	1	6	1	9	2	0

	s.	d.	q.	s.	d.	q.	s.	d.	q.	s.	d.	q.
1	0	0	3	0	0	3	0	0	3	0	1	0
2	0	1	1	0	1	0	0	1	3	0	1	0
3	0	1	3	0	1	3	0	2	2	0	2	2
4	0	2	1	0	2	1	0	3	1	0	3	3
5	0	3	0	0	3	0	0	4	0	0	4	3
6	0	3	3	0	3	3	0	5	0	0	5	3
7	0	4	0	0	4	2	0	5	3	0	6	3
8	0	4	3	0	5	1	0	6	2	0	7	3
9	0	5	2	0	6	0	0	7	1	0	8	3
10	0	6	0	0	6	3	0	8	1	0	9	2
11	0	6	3	0	7	2	0	9	0	0	10	2
12	0	7	1	0	8	1	0	9	3	0	11	2
13	0	7	3	0	9	0	0	10	2	1	0	1
14	0	8	2	0	9	3	0	11	1	1	1	2
15	0	9	0	0	10	2	1	0	0	1	2	1
16	0	9	2	0	11	1	1	1	0	1	3	0
17	0	10	1	1	0	0	1	1	3	1	4	1
18	0	10	3	1	0	3	1	2	2	1	5	0
19	0	11	2	1	1	2	1	3	2	1	6	1
20	1	0	0	1	2	1	1	4	1	1	7	0
21	1	0	3	1	3	0	1	5	0	1	8	1
22	1	1	0	1	3	3	1	5	3	1	9	0
23	1	1	3	1	4	2	1	6	2	1	10	1
24	1	2	1	1	5	1	1	7	3	0	11	0

The Price of the

Square	s.	d.	s.	d.	s.	d.	s.	d.
Square	9	0	10	0	11	0	12	0
$\frac{3}{4}$ Square	6	9	7	6	8	3	9	0
$\frac{1}{2}$ Square	4	6	5	0	5	6	6	0
$\frac{1}{4}$ Square	2	3	2	6	2	9	3	0

The Price of any Number of Feet, under 25, or $\frac{1}{4}$ of a Square.

	s.	d.	q.	s.	d.	q.	s.	d.	q.	s.	d.	q.
1	0	1	00	0	1	2	0	1	2	0	1	2
2	0	2	10	0	2	1	0	2	1	0	2	0
3	0	3	10	0	3	2	0	3	2	0	3	2
4	0	4	10	0	4	3	0	4	2	0	4	2
5	0	5	20	0	6	00	0	6	00	0	6	0
6	0	6	20	0	7	10	0	7	20	0	7	2
7	0	7	20	0	8	10	0	8	20	0	9	0
8	0	8	30	0	9	20	0	10	20	0	10	0
9	0	9	30	0	10	30	0	11	21	0	0	0
10	0	10	31	0	0	0	1	0	31	1	1	2
11	1	0	0	1	1	11	2	11	3	0		
12	1	1	0	1	2	11	3	21	4	2		
13	1	2	0	1	3	21	4	31	6	0		
14	1	3	0	1	4	31	6	11	7	2		
15	1	4	11	6	0	1	7	21	9	0		
16	1	5	11	7	11	8	32	1	1	2		
17	1	6	11	9	11	10	12	1	0			
18	1	7	21	9	21	11	22	1	2			
19	1	8	21	10	32	1	0	1	3	0		
20	1	9	22	0	0	2	2	11	4	1		
21	1	10	32	1	12	03	36	6	0			
22	1	11	32	2	12	4	31	7	2			
23	2	0	32	3	22	6	12	9	0			
24	2	1	02	4	32	7	22	10	2			

The Price of any Number of Feet, under 25, or quarter of a Rod.

The Price of the	Square		s.	d.	s.	d.	s.	d.	s.	d.	l.	s.	d.		
	Square		13	0	14	0	20	0	30	0	2	10	0		
	$\frac{3}{4}$ Square		9	9	10	6	15	0	22	6	1	17	6		
	$\frac{1}{2}$ Square		6	6	7	0	10	0	15	0	1	5	0		
	$\frac{1}{4}$ Square		3	3	3	6	5	0	7	6	0	12	6		
	s.	d.	q.	s.	d.	q.	s.	d.	q.	s.	d.	q.	s.	d.	q.
	10	1	3	0	1	2	0	2	2	0	3	3	0	5	0
	20	3	1	0	3	2	0	4	3	0	7	0	0	9	2
	30	4	3	0	5	0	0	7	1	0	10	3	1	2	2
	40	5	2	0	6	2	0	9	2	1	2	1	1	7	0
	50	7	3	0	8	0	1	0	0	1	6	0	2	0	0
	60	8	2	0	10	0	1	2	2	1	9	3	2	5	0
	70	10	3	0	11	2	1	4	3	2	1	0	2	9	2
	81	0	2	1	1	0	1	7	1	2	4	3	3	2	2
	91	2	1	1	2	2	1	9	2	2	8	1	3	7	0
	101	3	2	1	4	2	2	0	0	3	0	0	4	0	0
	111	5	1	1	6	0	2	2	2	3	3	3	4	5	2
	121	6	3	1	7	2	2	4	3	3	7	0	4	9	0
	131	8	0	1	9	0	2	7	1	3	10	3	5	2	2
	141	10	0	1	10	2	2	9	2	4	2	1	6	7	0
	151	11	1	2	0	0	3	0	0	4	6	0	6	0	0
	161	0	2	2	2	0	3	2	2	4	9	3	6	5	0
	171	2	2	2	3	2	3	4	3	5	1	0	6	9	2
	181	3	3	2	5	0	3	7	1	5	4	3	7	2	2
	192	5	3	2	7	0	3	9	2	5	8	1	7	7	0
	202	7	0	2	8	2	4	0	0	6	0	0	8	0	0
	212	9	0	2	10	0	4	2	2	6	3	3	8	5	0
	222	10	0	2	11	2	4	4	3	6	6	0	8	9	2
	233	0	0	3	1	0	4	7	1	6	10	3	9	2	2
	243	1	1	3	3	2	4	9	2	7	2	1	9	7	0

The Explanation of the foregoing TABLE.

First, In the Head of the Table, you have the Price of one Square; $\frac{3}{4}$ of a Square; $\frac{1}{2}$ of a Square, and $\frac{1}{4}$ of a Square, placed over each Column, calculated from 5 s. the Square, to 40 s. the Square; and by Addition, to 5 l. &c. per Square.

Secondly, In the first Column you have any Number of odd Feet under 25; and in the other

Columns, the Price or Rate of any Number of odd Feet, according to the Rate or Price, at the Head of the Column.

The Manner of using the Table is as follows.

Look for the Price at the Head of the Table, and under it you will find the Price of $\frac{3}{4}$ of a Square; $\frac{1}{2}$ a Square, and $\frac{1}{4}$ of a Square, and against the odd Feet, their respective Prices.

EXAMPLE I.

What are the Prices of $\frac{3}{4}$ of a Square, $\frac{1}{2}$ a Square, and $\frac{1}{4}$ of a Square, and 18 Feet, at 14 s. per Square?

	<i>l.</i>	<i>s.</i>	<i>d.</i>
The Square is - - - - -	00	14	00
The $\frac{3}{4}$ of a Square - - - - -	00	10	06
The $\frac{1}{2}$ of a Square - - - - -	00	07	00
The $\frac{1}{4}$ of a Square - - - - -	00	03	06
The 18 Feet - - - - -	00	02	05

The Sum is 01 : 03 : 05

EXAMPLE II.

What comes 22 Feet to, at 13 s. per Square?

Against 22 Feet in the first Column, you may find 30 s. in one Column, and under 13 s. at Value of 22 Feet, at 13 s. per the Head of the Table, is Square.

EXAMPLE III.

What comes 24 Feet to, at 1 l. 16 s. the Square?

In the upper Part of the Table, you may find 30 s. in one Column, you cannot find 36 s. but in another.

24 Feet at 30 s. is 7 s. $2\frac{1}{4}$ d. 24 Feet at 6 s. is 1 s. $5\frac{1}{4}$ d. so that 24 Feet at 36 s. per Square, comes to

$$\begin{array}{r} \text{s.} \quad \text{d.} \\ 7 : 2\frac{1}{4} \\ 1 : 5\frac{1}{4} \\ \hline 8 : 7\frac{1}{2} \end{array}$$

EXAMPLE IV.

What comes 15 Feet to, at 3 l. 19 s. per Square ?

	l.	s.	d.
15 Feet at 40 s. per Square, is - -	0	6	0
15 Feet at 30 s. per Square, is - -	0	4	6
15 Feet at 9 s. per Square, is - -	0	1	$4\frac{1}{4}$

The Sum is 0 : 11 : $10\frac{1}{4}$

EXAMPLE V.

What does 23 Feet come to, at 1 l. 12 s. 6 d. per Square ?

	l.	s.	d.
23 Feet at 20 s. per Square, is - -	0	4	$7\frac{1}{4}$
23 Feet at 10 s. per Square, is - -	0	2	$3\frac{1}{4}$
23 Feet at 5 s. 6 d. per Square, is } - -	0	0	$6\frac{1}{2}$
1 s. 1 d. whose half is - -	0	0	$6\frac{1}{2}$

The Sum is 0 : 7 : $5\frac{1}{4}$

TIMBER includes all kind of fell'd and season'd Woods; or those kind of Trees, which being cut down and season'd, are us'd in the several Parts of a Building, by the *Carpenter, Joiner, Turner, &c.*; these when cut down, are call'd *Timber*, and when growing, *Timber Trees*.

The Kinds of Timber are so numerous, that it would be tedious to mention them all. I shall content my self with mentioning the most common kinds of Timber, and their

Uses, as they are found set down in Mr. *Evelyn's Sylva*; and Mr. *Worlidge's Systema Agriculture*.

1. *Oak*. The several Uses of oaken Timber for Building and other Mechanick Uses, are so universally known, that it would be needless to ennumerate them.

There is no Wood comparable to it, for enduring all Seasons and Weathers; as for Pales, Shingles, Posts, Rails, Boards, &c. For Water Works it is second to none, especially where

it lies expos'd to the Air as well as the Water, there is none equal to it.

2. *Elm*; if it be fell'd between *November* and *February*, will be all Spine or Heart, and either none or very little Sap, and is of most singular Use (in the Water) where it lies always wet; and also where it may be always dry. Also the Toughness of it, renders it of great Use to Wheel-wrights, Mill-wrights, &c. it is also good for Dressers and Planks to chop on, because it is not liable to break and fly away in Chips, like other Timber.

3. *Beerb*; its chief Use is in Joinery, Turnery, Upholstery, and the like Mechanical Works; the Wood being of a white and fine Grain, and not apt to rend or split: yet it is sometimes us'd (especially of late Years) for Building Timber, and if it lies always wet (as in Ground Guts and the like) it is judg'd, that it will outlast even Oak it self.

4. *Ash*; the Use of *Ash* is almost universal. It is good for Building or other Occasions, where it may lie dry: it serves the Carpenter, Cooper, Turner, Plough-wright, Wheel-wright, &c. and for Garden Uses, no Wood exceeds it; as for Ladders, Hop-Poles, Palisade-Hedges, &c. and also at Sea, for Oars, Hand-Spikes, &c.

5. *Fir*; which is commonly known by the Name of *Deal*, and is of late much us'd in Building, especially within Doors, for Stairs, Floors, Wain-scot, and most ornamental Works.

6. *Walnut-Tree Timber* is of universal Use, excepting for the outside of Buildings: there is none better for the Joiner's Use, it being of a more curious brown Colour than Beach, and not so subject to the Worms.

7. *Chestnut Tree*: The Timber of this Tree is next to *Oak*, and is the most sought after by the Joiner and Carpenter, and is of very long lasting, as appears by many ancient Houses and Barns, built of it, about *Gravesend*, in *Kent*.

8. The *Service Tree*: The Timber of this Tree is useful for the Joiner, it being of a very delicate Grain, and is fit for divers Curiosities. It also affords Beams of a considerable Bigness for Building.

9. The *Poplar*, *Abel* and *Aspen*; which Kinds of Timber are very little different from one another, and of late, are much us'd instead of *Fir*; they look well, and are tougher and harder.

10. *Alder* is useful for the Poles of Ladders and Scaffolds, and also for Sewers and Pipes, for Conveyance of Water; for if it lie always wet, it will harden like a Stone it self; but where it is sometimes wet, and sometimes dry, it rots immediately.

11. *Lime-Tree*: Of this have been made Ladders, which have been excellently good, and of a very great Length.

The Time of felling Timber.

The Season of felling Timber, usually commences about the

the End of *April* (because at that Time, the Bark generally rises the most freely, and if there be any Quantity of Timber to be fell'd, the Statute obliges to fell it then, the Bark being necessary for the Tanner.

But the Opinions and Practices of Authors have been very different concerning the best Time to fell Timber.

Vitruvius recommends an autumnal Fall: others advise *December* and *January*: *Cato* was of Opinion, that Trees should have bore their Fruit before they were fell'd, at least their Fruit should be first ripe, which falls in with the Sentiment of *Vitruvius*.

And indeed tho' Timber unbark'd, be most obnoxious to the Worm, yet we find the wild Oak, and Timber fell'd too late, when the Sap begins to be proud, to be very subject to Worms; whereas being cut about Mid-Winter, it neither casts, rifts or twines, because the Cold of the Winter does both dry and consolidate it.

It would be happy therefore for our Timber, if a Method of tanning without so much Bark, could be found out, as the Honourable Mr. *Charles Howard* has most ingeniously offer'd, were become universal, that Trees being fell'd more early, the Timber might be fell'd more early, so as to be better season'd and condition'd for its various Uses.

The Ancients had a great Regard to the Age of the Moon, in felling their Timber, and the Presence of *Diana*

in *Sylvia* or the Woods, was not so much celebrated to credit the Fictions of the Poets, as for the Dominion of that moist Planet, and her Influence upon Timber.

If their Rules avail any Thing, they are these: Fell Timber in the Wane or Decrease, or four Days after the New Moon; and some advise, that it be in the last Quarter. *Pliny* advises, that it be in the very Article of the Change, which happening in the very last Day of the Winter-Solstice (he says) that Timber will prove immortal.

Columella says, from the 20th to the 30th Day: *Cato* says, four Days after the Full: *Vergilius* says, from the 15th to the 25th for Ship Timber; but never in the Increase, Trees then abounding with Moisture, which is the only Source of Putrefaction.

Some have Regard even to the Temper and Time of the Day, the Wind to be low, neither East nor West; neither in frosty, wet or dewy Weather, and therefore never in the Forenoon.

Lastly, Regard is to be had to the Species of Timber. It is best to fell Fir, when it begins to spring; both as it then quits its Coat best, and as the Wood (according to *Theophrastus*, is by that Means rendered wonderfully durable in Water.

Elm, says Mr. *Worlidge*, is to be fell'd between *November* and *January*; in which Case it will be all Heart; at least the Sap will be very considerable:

derable: He adds, that this is the only Season for felling *Ash*. Some Authors advise in the felling of Timber, to cut it but into the Pith, and so to let it stand till dry; by which Means the Moisture is evacuated in Drops, which would otherwise cause Putrefaction.

The Method of Seasoning Timber.

After Timber has been fell'd and sawn, it is next to be season'd; for the doing of which some advise that it be laid up very dry in an airy Place, yet out of the Wind and Sun, at the least, free from the Extremities of either; and that it mayn't decay, but dry evenly, they order that it be daub'd over with Cow Dung.

Let it not stand upright, but lay it along, one Piece upon another, only kept a-part by short Blocks interpos'd, to prevent a certain Mouldiness, which they are apt to contract by sweating one upon another; which frequently produces a *Fungus*, especially if there be any Sappy Parts remaining.

Others advite to lay Boards, Planks, &c. in some Pool or running Stream for a few Days, to extract the Sap from them, and afterwards to dry them in the Sun or Air. They say, that by this Means, they will neither chap, cast, nor cleave. Mr. *Evelyn* particularly commends this Way of Seasoning for Fir. Against shrinking there is no Remedy.

Some again advise to bury

them in the Earth; others in Wheat; and others are for scorching and seasoning them in Fire, especially Piles, Posts, &c. that are to stand, either in Water or Earth.

Sir *Hugh Plat* informs us, that the *Venetians* burn and scorch their Timber in the flaming Fire, continually turning it round with an Engine, till it has got a hard, black, crusty Coal upon it. And the Secret carries great Probability with it, for that the Wood is brought by it to such a Hardness and Drieness, that neither Earth nor Water can penetrate it.

Mr. *Evelyn* tells us, that he himself had seen Charcoal dug out of the Ground, amongst the Ruins of ancient Buildings, which in all Probability had lain covered with the Earth for near 1500 Years.

Of preserving Timber.

When Timber or Boards, &c. have been well season'd or dry'd in the Sun or Air, and fix'd in their Places, and what Labour you intend is bestow'd upon them, Care is to be taken to defend and preserve them, to which the smearing them with Linseed Oil or Tar, or the like oleaginous Matter, contributes much to their Preservation and Duration.

Hesiod prescribes to hang your Instruments in the Smoke to make them strong and lasting; if so, surely the Oil of Smoke (or the vegetable Oil by some other Means obtain'd) must

must needs be effectual for the Preservation of Timber.

The Practice of the *Hollanders* deserves our Notice, who, to preserve their Gates, Port Cullis's, Draw-Bridges, Sluices, &c. coat them over with a Mixture of Pitch and Tar, whereon they strew small Pieces of Cockles and other Shells, beaten almost to Powder, and mix'd with Sea Sand; which incrust and arm it wonderfully against all Assaults of Wind and Weather.

When Timber is fell'd before the Sap is perfectly at rest, it is very subject to the Worms; but to prevent and cure this, Mr. *Evelyn* recommends the following Secret, as the most approv'd.

Put common Sulphur into a Cucurbit, with as much *Aqua Fortis* as will cover it three Fingers deep; distil it to a Drieness, which is perform'd by two or three Rectifications.

Lay the Sulphur that remains at the Bottom, being of a blackish or sad red Colour, on a Marble, or put it in a Glass, and it will dissolve into an Oil; with this Oil anoint the Timber which is infected with Worms, or to be preserv'd from them.

It is a great and excellent *Arcanum* (he tells us) for tinging the Wood of no unpleasant Colour, by no Art to be wash'd out; and such a Preservative of all Manner of Woods, nay of many other Things also; as Ropes, Cables, Fishing-Nets, Masts of Ships, &c. that it defends them from Putrefaction,

either in Water, under, or above the Earth; in Snow, Ice, Air, Winter or Summer, &c.

It were superfluous to describe the Process of making the *Aqua fortis*; it shall suffice to let you know, that our common *Copperas* makes this *Aqua fortis* well enough for our Purpose, being drawn over by a Retort. And as for *Sulphur*, the Island of *St. Christophers* yields enough (which hardly needs any refining) to furnish the whole World.

This Secret for the curious I thought not proper to omit, tho' a more compendious Way may serve the Turn, three or four anointings, as to Posts, &c. this has been experimented in a Walnut Tree Table, where it has destroy'd Millions of Worms immediately, and is to be practis'd for Tables, Tubes, Mathematical Instruments, Boxes, Bed-Steads, Chairs, &c. the Oil of Walnuts will doubtless do the same; is sweeter and better than Varnish; but above all, Oil of Cedar, or that of Juniper is commended.

As for Posts or the like that stand in the Ground, the burning the Outfides of those Ends that are to stand in the Ground, is a great Preservative.

Sir *Hugh Plat* tells us of a *Kentish* Knight of his Acquaintance, who us'd to burn the Ends of his Posts for Railing and Paling; and this was likewise practis'd by Mr. *Walter Cuckfield* of *Suffex*, Esquire, with very good Success.

And this Practice was probably

bably deduc'd from the Observations that several made who digged the Earth, and found Charcoal, which, as they conjectured, had lain there 100 Years (nay Esq; *Evlyn* says 1500) and yet was not in the least inclin'd to Putrefaction, but was very firm and solid; which is a plain Demonstration, that Timber thus prepar'd, will resist Putrefaction much longer than it can do without it.

That this burning the Ends of Timber, is also practis'd in Germany, as appears by the Abstract of a Letter written by *David Vanderbeck*, a German Philosopher and Physician at *Minden*, to Doctor *Largelot*, registred in the *Philosophical Transactions*, N. 92. Page 585, in these Words: Hence also they slightly burn the Ends of Timber to be set in the Ground, that so by the *Fusion* made by the Fire, the *volatile Salts* (which by Accession of the Moisture of the Earth would easily be consum'd to the Corruption of the Timber) may catch and fix one another.

Of closing the Chops or Clefts in Green Timber.

Green Timber is very apt to split and cleave after it is wrought into Form; which is a great Eye Sore in fine Buildings.

This may be done by anointing, suppling and soaking it with the Fat of powdered Beef Broth, twice or thrice repeated; and the Chaps fill'd with Sponges, dipt into it; this is

to be done, as has been said, twice or thrice over.

Some Carpenters make Use of Grease and Saw Dust, mingled together for the same Purpose; but the first is so good a Way, (says our Author) that I have seen *wind-shock'd Timber* so exquisitely clos'd, as not to be discern'd where the Defects were. But this must be done while the Timber is green.

Of measuring of Timber.

Timber is commonly measured and sold by the Tun or Load, which is a solid Measure, containing 40 or 50 solid Feet, viz. 40 Feet of round Timber, and 50 Feet of hewn Timber; the Denomination of Load or Tun is suppos'd to arise from hence, that 40 or 50 solid Feet of such Timber, weighs about a Tun, i. e. 20 Hundred Weight, which is usually accounted a Cart Load.

1. *For measuring of Round Timber.*] The Custom is to gird the Tree about in the middle of the Length, and folding the Line twice to take one Length or a quarter of the whole, and to account that for the true Side of the Square. Then for the Length, 'tis accounted from the But-end of the Tree, so far up as the Tree will hold *half a Foot Girt*, as they phrase it, i. e. as long as the Line twice folded, is half a Foot.

The Dimensions thus taken, the Quantity of Timber may be measured, either, by multiplying the Side of the Square in

in it self, and that Product will be the Length by the Method of *Cross Multiplication*.

But more easily and speedily on *Gunter's Line*, by extending the Compasses from 12 to the Side of the Square in Inches; for that Extent turn'd twice (the same Way) from the Length in Feet, will reach to the Content in Feet.

But better still on *Coggleshal's Sliding Rule*, by setting 12 on the Girt Line D, to the Length of Feet in the Line C: then against the Side of the Square, on the Girt Line D, taken in Inches, you have on the Line C, the Content of the Timber in Feet.

Note 1. This Method of measuring round Timber, tho' it is common, is very erroneous; and the Content that is found hereby, 'tis demonstrated is less than the true Content or Measure in the Ratio of 11 to 14.

How to avoid this Error, and measure it justly, is shewn under the Use of *Coggleshal's Sliding Rule*. Which see.

2. If the Tree have any great Boughs or Branches that have Timber (as they phrase it) *i. e.* which will hold half a Foot Girt, they are usually measured and added to the rest: the Solidity of the whole being thus found, they divide it by 40, which brings it into Loads or Tuns.

3. In measuring Round Timber for Sale, they usually cast away an Inch out of the Squares for the Bark, if Oak; so that a Tree 10 Inches square, they reckon it as if it were but 9;

but for *Ash, Elm and Beach*, an Inch is too much to be allow'd for the Bark.

Again, this Way of taking $\frac{3}{4}$ of the Circumference for the true Square, is erroneous, and always gives the Solidity less than the Truth, by about a fifth Part.

For measuring beewn or squared Timber.] The Custom is to find the middle of the Length of the Tree, and there to measure its Breadth, by clapping two Rules or other strait Things to the Sides of the Tree, and measuring the Distance between them; in the like Manner they measure the Breadth the other Way: If the two be unequal, they add them together, and take half the Sum for the true Side of the Square.

The Dimensions thus taken, the Content is found either by *Cross Multiplication*, *Gunter's Scale*, or the *Sliding Rule*, after the Manner already directed, the Content divided by 50, gives the Number of Loads.

If the unequally, this Method of measuring it, is erroneous; always giving the Content more than the Truth, and the more so, as the Difference of the Sides is the greater; yet Custom has authoriz'd it, to measure such Timber justly, a mean Proportional should be found between the unequal Sides; and this mean be accounted the Side of the Square.

The Measuring of Board and Timber.

By Scale and Compasses.

i. Of Board-Measure.

To measure a Board, is no other but to measure a long Square.

Example 1. If a Board be 16 Inches broad, and 13 Feet long, how many Feet is contain'd therein?

Multiply 16 by 13, and the Product is 208; which divided by 12, gives 17 Feet, and 4 remains, which is a third Part of a Foot.

Or thus: Multiply 156 (the Length in Inches) by 16, and the Product is 2496; which divided by 144, the Quotient is 17 Feet, and 48 remains, which is a third Part of 144, the same as before.

$$\begin{array}{r}
 12 : 13 :: 16 \\
 13 \\
 \hline
 48 \\
 16 \\
 \hline
 12) 208 \\
 \hline
 17 \frac{4}{12}
 \end{array}$$

$$\text{Or, } 144 : 156 :: 16$$

$$\begin{array}{r}
 16 \\
 \hline
 936 \\
 156 \\
 \hline
 144) 2496 (17 \frac{48}{144} \\
 \hline
 1056 \\
 \hline
 48
 \end{array}$$

Extend the Compasses from 12 to 13, that Extent will reach from 16 to 17½ Feet, the Content.

Or, extend from 144 to 156, (the Length in Inches) that Extent will reach from 16 to 17½ Feet, the Content.

Example 2. If a Board be 19 Inches broad, how many Inches in Length will make a Foot?

Divide 144 by 19, and the Quotient is 7.58 very near; and so many Inches in Length, if a Board be 19 Inches broad, will make a Foot.

$$\begin{array}{cccc}
 \text{I.} & \text{I.} & \text{I.} & \text{I.} \\
 19 : 144 :: 1 : 7.58 \text{ fere.}
 \end{array}$$

Extend the Compasses from 19 to 144, that Extent will reach from 1 to 7.58; that is, 7 Inches, and something more than a half. So, if a Board be 19 Inches broad, if you take 7 Inches and a little more than a half with your Compasses from a Scale of Inches, and run that Extent along the Board, from End to End, you may find how many Feet that Board contains; or you may cut off from that Board, any Number of Feet desir'd.

For this Purpose there is a Line upon most ordinary Joint-Rules, with a little Table plac'd upon the End of all such Numbers as exceed the Length of the Rule, as in this little Table annex'd.

0	0	0	0	5	0	8½	6
12	6	4	3	2	2	1	1
1	2	3	4	5	6	7	8

Here you see, if the Breadth be one Inch, the Length must be 12 Feet; if two Inches, the Length is 6 Feet; if five Inches broad, the Length is 2 Feet, 5 Inches, &c.

The rest of the Lengths are express'd in the Line: thus if the Breadth be 9 Inches, you will find it against 16 Inches, counted from the other End of the Rule; if the Breadth be

11 Inches, then a little above 13 Inches, will be the Length of a Foot, &c.

§ 2. Of Squar'd Timber.

By Squar'd Timber is here meant all such as have equal Bases, and the Sides strait and parallel.

Example 1. If a Piece of Timber be 1 Foot, 3 Inches (or 15 Inches) square, and 18 Feet long, how many solid Feet are contain'd therein?

	F.	I.
15	1	3
15	1	3
—	—	—
75	1	3
15		3 9
—	—	—
225	1	6 9
18		6
1800		—
225	9	4 6
—		3
144)4050 (28.125	28	1 6
—	—	—
1170		
—		
180		
360		
720		

Answer, 28 Feet and half a quarter.

Here, instead of multiplying by 18, (where I wrought by Feet and Inches) I multiply'd by 6, and then by 3, because 3 times 6 is 18.

Example 2. If a Piece of squar'd Timber be 2 Feet 9

Inches deep, and 1 Foot 7 Inches broad, and 16 Feet 9 Inches long, how many Feet of Timber are in that Piece?

Multiply the Depth, Breadth and Length together, and the Product will be the Content.

	F.	I.
33	2	9
19	1	7
<hr/>	<hr/>	<hr/>
297	2	9
33	1	7 3
<hr/>	<hr/>	<hr/>
627	4	4 3
16.75	16	9
<hr/>	<hr/>	<hr/>
3135	69	8 0
4389	3	3 2 3
3762		
627	72	11 2 3
<hr/>		

144) 10502.25 (72.93

422
1342
465

33
Answer, 72 Feet, 11 Inches ; or, 72 Feet, 93 Parts.

By Scale and Compasses.

For the first Example, extend the Compasses from 12 to 15 Inches, (the Side of the Square) that Extent will reach from 18 Feet (the Length being twice turn'd over) to 28 Feet and something more.

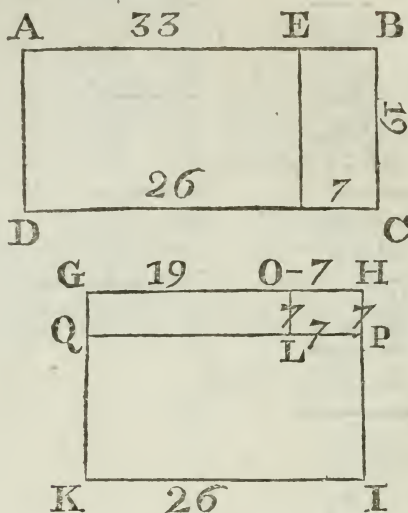
For the second Example, find a mean Proportional between 19 Inches and 33 Inches, by dividing the Space between them into two equal Parts; and the Compass Point will rest upon .25, which is a mean Proportional between 19 and 33.

Then extend the Compasses from 12 to 25, (the Propor-

tional found) that Extent will reach (being twice turn'd over) from 16.75 Feet, the Length, to 72.93 Feet, the Content.

A common Error is committed, for want of Art, in measuring these last Sorts of Solids, by adding the Depth and Breadth together, and taking half for the Side of a mean Square. This Error, tho' it be but small, when the Depth and Breadth be pretty near equal; yet if the Difference be great, the Error is very considerable; for the Piece of Timber, thus measur'd, will be more than the Truth, by a Piece whose Length is equal to the Length of the Piece of Timber

Timber to be measur'd, and Depth, as I shall here demonstrate. the Square equal to half the Difference of the Breadth and



I say, the Square $GHIK$, is greater than the Parallelogram $ABCD$, by the little Square $OHPL$; for the Parallelogram $QPIK$, is equal to the Parallelogram $AEDF$; and the Parallelogram $GOLQ$, is equal to the Parallelogram $EBCF$. Therefore the Square is greater than the Parallelogram, by the little Square $OHPL$; which was to be prov'd.

Otherwise, you may prove it by Numbers, thus; the Sum of 33 and 19, is 52; the half thereof is 26; the Square of

26 is 676; and the Product of the Depth and Breadth, is 627; the Difference of these two is 49, equal to the Square of half the Difference; for the Difference between 33 and 19, is 14, the half thereof is 7, whose Square is 49. Which was to be prov'd.

Now, if this 49 be multiply'd by the Length of the Piece, and that Product divided by 144, to bring it to Feet, and those Feet added to the true Content, the Sum will be equal to the Content, found by the false Way mention'd.

See the Work of both.

38 Depth. 16.75 the Length.
19 Breadth. 49 the Square of $\frac{1}{2}$ Diff.

52 Sum.

15075
6700

26 half.

26

4)820.75(5.69

156

1007

52

1435

67.6

139

16.75

3380

4732

4056

676

144)11323.00(78.63

1243

910

460

28

Feet

To 72.93 the true Content,
Add 5.69 the Part superfluous.

Rem. 78.62 equal to the Content by the false Way.

By Feet and Inches.

F. I.

0 7

0 7

0 4 1

16 9

5 5 4

3 0 9

5 8 4 9 Part superfluous.

72 11 2 3 true Content add.

78 7 7 0 equal to the Content by the false Way.

F. I.

2

2 2

4 4

4 4

4 8 4

16 9

75 1 4

3 6 3

False C. 78 7 7

To find how much in Length makes a Foot of any squar'd Timber.

Always divide 1728 (the solid Inches in a Foot) by the Area of the Base; the Quotient is the Length of a Foot.

This Rule is general for all Timber, which is of equal Thickness from End to End, whether it be square, triangular, multangular, or round.

Example 1. If a Piece of Timber be 18 Inches square, how much in Length will make a Foot solid?

18

18

144

18

324) 1728 ($5\frac{1}{2}$ •

1620

108

Answer, 5 Inches and $\frac{1}{2}$

By Scale and Compasses.

Extend the Compasses from 1 to 18, that Extent will reach from 18 to 324, the Square or Area of the Base; then extend from 324 to 1728, that Extent will reach down from 1 to 5 Inches and $\frac{1}{2}$ of an Inch.

Or thus: Extend the Compasses from 18 to 41.569, that Extent turn'd twice over from 1, will at last fall upon $5\frac{1}{2}$, as before.

Note, That 41.569 is the square Root of 1728.

Example 2. If a Piece of Timber be 22 Inches deep and 15 Inches broad, how much in Length will make a Foot?

$$\begin{array}{r}
 22 \\
 15 \\
 \hline
 110 \\
 22 \\
 \hline
 330 \overline{) 1728} (5.23 \\
 \underline{780} \\
 1200 \\
 \hline
 210
 \end{array}$$

Answer, 5 Inches and .23 Parts.

By Scale and Compasses.

Extend the Compasses from 1 to 15, that Extent will reach from 22 to 330; then extend from 330 to 1728, that Extent will reach from 1 to 5.23 Inches, the Length of a Foot.

There is a Line for this Purpose upon most ordinary Rules, with a little Table at the End of all such Numbers as exceed the Length of the Rule, such as this annex'd.

0	0	0	0	9	0	11	3	9	Inches.
144	36	16	9	5	4	2	2	1	Feet.
1	2	3	4	5	0	7	8	9	Side of the Sq.

Here it is to be seen, that if the Side of the Square be 1, the Length must be 144 Feet; if two Inches be the Side of the Square, it must be 36 Feet in Length, to make a solid Foot, &c.

If the Side of the Square be not in the little Table, it may be found upon the Line; thus if the Side of the Square be 16 Inches, you will find it against 6 Inches, and 7 tenths, counted from the other End of the Rule.

Then, if you take the Length of a Foot from the Line of Inches with the Compasses, and run the Compasses along the Piece from End to End, you will find how many Feet are contain'd in that Piece; or you may cut off any Number of solid Inches that shall be desired; but if the Sides of the Piece be unequal, then you are to find a mean Proportional Number, as has been before

taught, by dividing the Distance upon the Line of Numbers into two equal Parts.

Thus, if the Breadth be 25 Inches, and the Depth 9 Inches, divide the Space upon the Line of Numbers into two equal Parts, and you will find the middle Part at 15; so is 15 Inches the Geometrical mean Proportional sought; then if you look for 15 upon the Line above-mentioned, you will find 7 Inches and a little above half to be the Length of a Foot.

§ 3. Unequal Squar'd Timber.

Unequal squar'd Timber is all such as hath unequal Bases; *i. e.* that is thicker at one End than the other; and such the Generality of Timber Trees are, when they are hewn and brought to their Squares.

The usual Way of measuring such Timber is, to take

a Square about the middle of the Piece, which is suppos'd to be a mean Square: This Way comes pretty near to the Truth,

when the Piece is pretty near as thick at one End as at the other; but the Error is very considerable, when there is a great Disproportion between the Ends of the Piece, all such Solids being the *Frustums* of *Pyramids*; the true Way of measuring them must be by the Directions given for mea-

suring the *Frustum* of a *Pyramid*. See *Pyramid*, and *Frustum of a Pyramid*.

I shall give an Example or two, wrought both by the true and the false way; by which you may see the Difference.

Example 1. If a Piece of Timber be 25 Inches square at the greater End, and 9 Inches square at the lesser End, and 20 Feet long, how many Feet of Timber are in that Tree?

$$\begin{array}{r}
 25 \\
 9 \\
 \hline
 \text{Sum } 34 \\
 \hline
 \text{Half } 17 \text{ the Side of the Square in the middle.} \\
 17 \\
 \hline
 119 \\
 17 \\
 \hline
 289 \\
 20 \\
 \hline
 144 \overline{) 5780} (40.13 \\
 \underline{0200} \\
 560 \\
 \hline
 128
 \end{array}$$

Answer 40.13 Feet, by the false Way.

$$\begin{array}{r} 25 \\ 9 \\ \hline 225 \end{array}$$

$$\begin{array}{r} 25 \\ 9 \\ \hline 16 \text{ Difference of the Sides.} \\ 16 \\ \hline 96 \\ 16 \\ \hline 3)256 \text{ the Square.} \end{array}$$

$$\begin{array}{r} 85.333 \\ 225 \\ \hline 310.333 \\ 20 \\ \hline 144)620.6660(43.101 \\ \hline 446 \\ 146 \\ 266 \\ \hline 122 \end{array}$$

Answer 43.101 Feet by the true way; so that there is near 3 Feet difference.

By Scale and Compasses.

Length, to 43.1 Foot, the Content the true way.

Extend the Compasses from 1 to 9, that Extent will reach from 25 (the same way) to 225 the Rectangle of the Sides of the two Bases; then the Difference between the said Sides is 16: extend the Compasses from 3 to 16, and that Extent will reach from 16 to 85.333, a third Part of the Square; which being added to 225, the Sum is 310.333 a mean Area: then extend the Compasses from 144 to 310.333, and that Extent will reach from 20, the

Extend the Compasses from 12 to 17 (the Side of the middle Square) and that Extent will reach from 20 (the Length being twice turn'd over) to 40.1. Feet, the Content by the false way.

Example 2. If a Piece of Timber be 32 Inches broad and 20 Inches deep, at the greater End, and 10 Inches broad and 6 deep at the lesser End, and 18 Foot long, how many Feet of Timber are in that Piece?

T I

32
20
—
640
60
—

...
38400
1
—

29)284
385)-2300
3909)-375000
39185)-231900
391909)-359750

144)5375.754(37.33
—

1055
477
455
—
23

Answer { Content the true way }
37.33 Feet.
Content the false way }
34.12 Feet.

T I

6
10
—
60

195.959 mean Prop.
640 the greater Base.
60 the lesser Base.

895.959 the Sum.
6½ the Height.

5375.754

Add 32 20
10 6
—

Sum 42 26 Sum.

Half 21 13 half.

13
—
63
21
—

273 Area in the mid.
18 Length.

1284
273
—

144)4914(34.12
—

594
180
360
—

72

By Scale and Compaffes.

Extend the Compaffes from 1 to 20, and that Extent will reach from 32 to 640, the Area of the greater Bafe.

Then extend them from 1 to 60, and that Extent will reach from 640 to 38400, the Product of the two Areas.

Find the fquare Root of it, by dividing the Space between 1 and 38400 into two equal Parts, and fo you will find the middle Point at 195.959 the Root fought; which is a mean Proportional between the greater and leffer Areas.

Then add the mean Proportional and two Areas together, and the Sum will be 895.959; which being multiply'd by 6 (a third Part of the Length) by extending from 1 to 6, and that Extent will reach from 895.959, to 5375.75.

Then extend them from 144 to 5375.75, and that Extent will reach from 1 to 37.33 Feet the true Content.

For the falfe way, half the Sum of the Breadths is 21, which is the Breadth in the middle; and half the Sum of the Depths is 13: Extend the Compaffes from 1 to 13, and that Extent will reach from 21 to 273, the Area of the middle Bafe: then extend them from 144 to 273, and that Extent will reach from 18 (the Length) to 34.12, the Content the falfe way.

Of meafuring round Timber, whose Bafes are equal.

The common way of mea-

furing round Timber Trees, is to girt them about the middle with a String, and to take the fourth Part of that Girt for the Side of a Square, by which the Piece of Timber is meafured as if it was fquare.

But that this is an Error, will be made appear by what follows.

If the Circumference of a Circle be 1. the Area will be .07958; then the fourth Part of 1 is .25, which being fquared, makes .0625; this they fuppose to be a mean Area, inftead of .07958: therefore the true Content always bears fuch Proportion to the Content found by the faid customary falfe way, as .07958 to .0625; which is nearly as 23 to 18; fo that in meafuring by that customary falfe way, there is above the one fifth Part loft of what the true Content ought to be.

This Error, tho' it has been fo often confuted, yet it is grown fo customary every where, that there is but little Hopes of prevailing with Perfons to embrace the Truth; but however, I fhall proceed in the following Examples to give the Operations both by the true way, and the falfe customary way.

Example 1. If a Piece of Timber be 96 Inches in Circumference or Girt, and 18 Feet in Length, how many Feet of Timber does it contain?

a fourth Part of 96 is 24

24

96

48

576 Area Base.

18

4608

576

144)10368

1008

288

288

...

Or thus F.

I.

2

0

2

0

4

0

18

72

0

Content the false way, 72 Feet.

The Operation the true way.

96

96

576

864

9216

107958

73728

46080

82944

64512

733.40928 the Area

18

586727424

73340928

13201.36704

44)13201.36704(91.67

241

973

1096

88

The true Content 91.67 Feet.

By Scale and Compasses.

Extend the Compasses from 12 to 24 (the fourth Part of the Girt) and that Extent

turn'd twice over from 18 Feet (the Length) will at last fall upon 72 Feet, the Content the customary way.

Extend again from 42.54 to

96 (the Girt) and that Extent will reach from 18 Feet (turn'd twice over) to 91.67 Feet the true Content.

Example 2. If a Piece of Timber be 86 Inches Girt, and 20 Feet long, how many Feet does it contain?

The fourth Part of 86 is 21.5

F.	I.	P.	
1	9	6	21.5
1	9	6	<u>21.5</u>
			1075
1	9	6	215
1	4	1 6	<u>430</u>
	0	10 9	262.25
			<u>20</u>
3	2	6 3	
		20	144) 9245.00 (64.2
			<u>605</u>
64	2	5 0	290
			<u>20</u>

The Content the false way, 64.2 Feet.

The Operation the true way.

86	588.57368
86	<u>20</u>
<u>516</u>	
688	144) 11771.47360 (81.74
<u>7396</u>	
07958	<u>251</u>
<u>59168</u>	1074
36980	667
66564	<u>91</u>
51772	
<u>588.57368</u>	

The true Content is 81.74 Feet.

By Scale and Compasses.

Extend the Compasses from 12 to 21.5, and that Extent turn'd twice over from 20, will reach at last to 64.2 Feet; the Content the false way.

Again, extend the Compasses from 42.64 to 86, and that Extent turn'd twice over from 20, will at last fall upon 81.74 Feet, the true Content.

§ 4. *The measuring of Round Timber, whose Bases are unequal.*

The customary way of measuring Round Timber (as has been said before) is to take a fourth Part of the Girt in the middle of the Piece, for the Side of a mean Square.

But this way has been prov'd to be erroneous in Timber that is all the Length of an equal

Thicknes; and it must of Necessity be much more so in Timber that is tapering; and the greater will the Error be, the more tapering the Timber is. For to an Error in the last foregoing Section, there will be added the Error in the preceeding Section; therefore in order to measure all such Timber according to Art and Truth, such a Piece ought to be considered as a *Frustum* of a Cone, and should be measured by Rules given for measuring that; by which Rules the following Examples are wrought.

Example 1. If a Piece of Timber be 9 Inches Diameter at the lesser End; and 36 Inches at the other End, and 20 Feet in Length, how many Feet of Timber does it contain?

36	36	} Subtract.	7854
9	9		567
<hr/>			
Rect. 324	27	Difference.	54978
	27		47124
	<hr/>		39270
	189		
	54		445.3218 a mean Area.
	<hr/>		24
	3)729	the Square.	
	<hr/>		17812872
	243	one third.	8906436
	324	Rectangle add.	<hr/>
	<hr/>		144)10687.7232(74.22
	576		
			607
			317
			292
			<hr/>
Answer 74.22 Feet.			4

Or thus, by Feet and Inches.

F.	I.
3	0
0	9
<hr/>	
2	3 Rect.

F.	I.	
2	3	Difference.
2	3	
<hr/>		
4	6	
0	6	9
<hr/>		
5	0	9 the Square.
<hr/>		
1	8	3 one third.
2	3	0 Rect. added.
<hr/>		
3	11	3 a mean Sq.

Then as 14 is to 11, so is 3 : 11 : 3 to the Area.
11

<hr/>			
7)	43	:	3 : 9
<hr/>			
2)	6	:	2 : 3
<hr/>			
	3	:	1 : 1 : 6
			6
<hr/>			
	18	:	6 : 9 : 0
			4
<hr/>			
	74	:	3 : 0 : 0

Here instead of dividing by 14, I divide by 7 and by 2, because twice 7 is 14.

And instead of multiplying by 24 Feet (the Length) I multiply by 6 and by 4, because 6 times 4 is 24.

By Scale and Compasses, this is too troublesome.

Example 2. If a Piece of Timber be 136 Inches in Circumference at one End, and but 32 Inches Circumference at the other End, and 20 Feet in Length, how many Feet of Timber does that Piece contain?

$$\begin{array}{r}
 136 \\
 32 \\
 \hline
 272 \\
 408 \\
 \hline
 4352
 \end{array}$$

$$\begin{array}{r}
 136 \\
 32 \\
 \hline
 104 \text{ Difference.} \\
 104 \\
 \hline
 416 \\
 104 \\
 \hline
 \end{array}$$

3)10816 the Square:

$$\begin{array}{r}
 3605.333 \text{ one third.} \\
 4352 \text{ Rectangle add.} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 7957.333 \text{ a mean Circum. squar'd.} \\
 .07.958 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 63658664 \\
 39786665 \\
 71615997 \\
 55701331 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 633.24456014 \text{ the mean Area.} \\
 21 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 633.24456014 \\
 12664 \ 8912028 \\
 \hline
 \end{array}$$

$$13298.13576294$$

$$144)13298.13(92.34$$

$$\begin{array}{r}
 338 \\
 501 \\
 693 \\
 \hline
 117
 \end{array}$$

Answer 92.34 Feet.

By Feet and Inches thus.

F.	I.
11	: 4
2	: 8
<hr/>	
22	: 8
7	: 6 : 8
<hr/>	
32	: 2 : 8
<hr/>	

F.	I.	
8	: 8	Difference.
8	: 8	
<hr/>		
69	: 4	
5	: 9 : 4	
<hr/>		
3)75	: 1 : 4	the Square.
<hr/>		
25	: 0 : 5 : 4	
30	: 2 : 8 : 0	
<hr/>		
55	: 3 : 1 : 4	the Sq. of the (Circumference.

	F.	I.	P.	S.	
88	: 7	: :	55	: 3 : 1	: 4 the mean Area.
<hr/>					7
11)386	: 9	: 9	: 4		
<hr/>					
8)35	: 1	: 11	: 9		
<hr/>					
	4	: 4	: 8	: 11	the mean Area.
<hr/>					7
	30	: 9	: 2	: 5	
<hr/>					3
<hr/>					
Facit	92	: 3	: 7	: 3	

The Price of felling and hewing of Timber.] They have 1 s. and 14 d. per Load for felling of Timber, and about 3 s. per Load for hewing.

How much Timber goes to a Square of Framing.] Mr. Leybourn tells us that 20 Foot of solid Timber (cut into convenient Scantlings) will compleat a Square (*i. e.* 100 Superficial

Feet) of any Building great or small, *i. e.* the Carcass, *viz.* outside Frame, Partitions, Roof and Floors.

TONDINO [in *Architecture.*] See *Tore.*

TOP-BEAM. See *Collar-Beam.*

TORUS } [in *Architecture*]
TORUS } is a thick, round Moulding, us'd in the Bases of Columns

Columns: It is the bigness that distinguishes the *Torus* from the *Astragal*.

TORSEL. See *Tassels*.

TRACTRIX [in *Geometry*] a curve Line, call'd also *Catenaria*.

TRABEATION is the same as *Entablement*.

TRAMMEL, an Iron moving Instrument in Chimneys, whereon they hang the Pot over the Fire.

TRANSMISSION [in *Opticks*, &c.] The Act of a transparent Body, passing the Rays of Light through its Substance, or suffering them to pass, in which Sense, the Word stands in Opposition to Reflection.

TRANSOM [in *Building*] a Piece that is fram'd cross a double Window-light.

Mr. *Wing* says, Transom Windows in great Buildings, are worth 6 s. 9 d. or 7 s. per Window.

TRANSMUTATION [in *Geometry*] is the reducing or changing one Body into another of the same Solidity, but of a different Figure; as a Triangle into a Square; a Pyramid into a Parallelopiped, &c.

TRANSVERSE, Going across from the right to the left.

TRAPEZIUM, is a Figure having four unequal Sides and oblique Angles. See *Pl. Fig. 3*.

To find the Area or Superficial Content.

and multiply that half Sum by the Diagonal; or multiply the whole Sum by half the Diagonal, and the Product will be the Area, or

You may find the Area's of the two Triangles A B C, and A C D (by the Rules for Triangles) and add those Area's together, and the Sum will be the Area of the *Trapezium*. See *Triangle*.

$$D F = 30.1$$

$$D E = 24.5$$

$$\text{Sum } 54.6$$

$$\text{Half } 27.3$$

$$A C = 80.5$$

$$1365$$

$$2184$$

$$\text{Area } 2197.65$$

Let *ABCD* be a *Trapezium* given, the Diagonal of which is 80.5, and the Perpendicular *BF* 30.1, and the Perpendicular *DE* 24.5. These two being added together, the Sum is 54.6. the half of which is 27.3. which multiply'd by the Diagonal 80.5, the Product will be 2197.65, which is the Area of the *Trapezium*; or

If 40.25 half the Diagonal, be multiply'd by 54.6 the whole Sum of the Perpendiculars, the Product will be 2197.65, the same as before.

The RULE.

By Scale and Compasses.

Add the two Perpendiculars together, and take half the Sum

Extend the Compasses from 2 to 54.6; and that Extent will reach

reach from 80.5 to 2197.65, the Area.

Demonstration.

This Figure *ABCD* is compos'd of two Triangles; the Triangle *ABC* is half the Parallelogram *AGHC*: also the Triangle *ACD* is equal to half the Parallelogram *ACIK* as is prov'd.

Wherefore the *Trapezium ABCD*, is equal to half the Parallelogram *GHIK*. See *Triangle*.

To find the Area $HI = BF + DE$; therefore half $HI \times AC (= KI = GH) =$ Area of the *Trapezium*: which was to be prov'd.

To TRAVERSE [in *Joinery*] signifies to plane a Board or the like, a-cross the Grain.

TRAVERSE *Tile*. See *Tile*.

TRELLIS, an Assemblage or setting together of wooden or iron Bars, which cross one another in a strait Line or slopingly; the Use of it being for Wall-Fruit Trees. You must first cramp some Hooks, check-erwise into the Wall, three Foot distant from one another, leaving two Inches jutting out, to set the Poles or Props upon: Oak being the most lasting, is most in request, provided there be no Sap in it; having gotten together a sufficient Quantity of Props, the Carpenter must make them smooth and strait, without weakening them; and place them on Hooks, one over another; the Square ought to be seven Inches wide and eight high; an oblong Square will

be more graceful than one that is perfect; you may fasten them together with Wire, and when the *Trellis* is finish'd, if the Props are painted in some Oil Colour, it will make them last the longer.

There is another Sort of *Trellis* made of Iron Wire; for which suppose the Wall where you are to make it be nine Foot, your Bearers must be of an equal Height, fix'd in three Rows, two Foot distant one from another, and must place your Poles upon every Row, each nine Foot long, join'd together at the Ends, and fastened to the Bearers of every Row with an Iron Wire.

These Poles are to be continued the Height of the Wall, from six Fathom to six Fathom, tied to one of the Bearers of every Row; the Poles are put upon the Bearers, because the Wire *Trellis* may be well tyed and fastened.

The Squares are to be made after the Manner of those of Wood; that is, seven Inches long, and eight high; your Expence this way, will be two thirds less than the other, and the Work will last infinitely longer.

If instead of Props, you made Use of Iron Rods, such as Glaziers use in their Casements, they would continue a long time serviceable.

TRIANGLE [in *Geometry*] is a Figure comprehended under three Lines, and which consequently has three Angles.

If the three Lines or Sides of the *Triangle* be right, it it

said to be a *plane* or *rectilinear* *Triangle*.
 If all the three Sides of the *Triangle* be equal, it is call'd an *equilateral Triangle*.

If only two Sides of the *Triangle* be equal to one another, it is call'd an *Isoceles* or *Equicrural Triangle*.

If all the Sides of the *Triangle* be *nuequal*, it is call'd a *scalenous Triangle*.

If one of the *Angles* of a *Triangle*, be a *Right Angle*, the *Triangle* is said to be *rectangular*.

If one of the *Angles* of a *Triangle* be obtuse, the *Triangle* is said to be *obtuse angular*, or *amblygonous*.

If all the *Angles* be acute, the *Triangle* is said to be *acute angular*, or *oxygonous*.

If the three *Lines* of the *Triangles* be all *Curves*, the *Triangle* is said to be *curvilinear*.

If some of the Sides of a *Triangle* be right, and others

curve, it is said to be *mixtilinear*.

TRIANGLE is a Figure having three Sides and three Angles.

To find the *Superficial Content* of a *Triangle*.

The *RULE*.

Let the *Triangle* be of what Kind soever, multiply the *Base* by half the *Perpendicular*, or half the *Base* by the whole *Perpendicular*; or multiply the whole *Base* by the whole *Perpendicular*, and take half the *Product*, any of these three ways will give the *Content*.

Let *ABC* be a right angled *Triangle*, whose *Base* is 14.1 Feet, and the *Perpendicular* 12 Feet; multiply 14.1 by 6, half the *Perpendicular*, and the *Product* will be 84.6 Feet, the *Content*: or,

Multiply 14.1 by 12, the *Product* will be 169.2, the half of which is 84.6, the same as before. Fig. 4.

14.1 Base
 6 half Perpendicular

84.6 Product

14.1 Base
 12 Perpendicular

169.2 Product

84.6 half

By *Scale and Compasses*.

Extend the *Compasses* from

2 to 14.1, that *Extent* will reach the same way from 12 to 84.6 Feet, the *Content*.

15.4 Base.
 3.9 half Perpendicular.

1386

462

60.06 Product.

$$\begin{array}{r}
 15.4 \text{ Base} \\
 7.8 \text{ Perpendicular} \\
 \hline
 1232 \\
 1078 \\
 \hline
 120.12 \\
 \hline
 60.06
 \end{array}$$

$$\begin{array}{r}
 7.7 \text{ half Base.} \\
 7.8 \text{ Perpendicular} \\
 \hline
 616 \\
 539 \\
 \hline
 60.06
 \end{array}$$

Let ABC (Figure 5) be an oblique-angled Triangle given, whose Base is 15.4, and the Perpendicular 7.8. If 15.4 be multiply'd by 3.9 (half the Perpendicular) the Product will be 60.06 for the Area or Superficial Content: Or if the Perpendicular 7.8 be multiply'd into half the Base, 7.7, the Product will be 60.06 as before: Or if the whole Perpendicular 7.8, the Product will be 120.12 which is the double Area; the half of which is 60.06 Feet, as before.

In Figure 5. the Parallelogram $ABEF$, is also double to the Triangle ABC , for the Triangle ACF is equal to the Triangle ACD , and the Triangle BCE is equal to the Triangle BCD ; therefore the Area of the Parallelogram is double to the Area of the given Triangle, which was to be prov'd.

To find the Area of any Plain Triangle, by having the three Sides given, without the Help of a Perpendicular.

By Scale and Compasses.

Extend the Compasses from 2 to 15.4, that Extent will reach from 7.8 to 60.06 Feet, the Content.

Demonstration.

If AD (Fig. 4.) be drawn parallel to BC , and DC parallel to AB ; the Triangle ABC shall be equal to the given Triangle ADC .

Hence the Parallelogram $ABCD$ is double to the Triangle given; therefore half the Area of the Parallelogram is the Area of the Triangle.

The RULE.

Add the three Sides together, and take half that Sum; then subtract each Side severally from that half Sum. This being done, multiply that half Sum and the three Differences continually, and out of the last Product extract the Square Root, which Square Root shall be the Area of the Triangle sought.

Example. Let ABC Fig. 5. be a Triangle, whose three Sides are as follows, viz. AB , 43.3. AC , 20.5 and BC 31.2, the Area is required,

T R

T R

$$\text{Sides } \left\{ \begin{array}{l|l} 43.3 & 4.2 \\ 31.2 & 16.3 \\ 20.5 & 27.0 \end{array} \right\} \text{Differences.}$$

Sum 95.0

Area 296.31. 47.5 half Sum.
27 Difference.

3325
950

1282.5 Product.
163 Difference.

38475
76950
12825

20904.75 Product.
4.2 Difference.

4180950
8361900

8799.9500

87799.9500 (296.31
4

49)477
441

586)3699
3516

5923)18395
17769

59261)52600
59261

3339 Remains.

Demon-

Demonstration.

In the Triangle BCD, *Fig. 7.* if from the half Sum of the Sides you subtract each particular Side, and multiply the half Sum and the three Differences together, the square Root of the Product shall be the Area of the Triangle.

First, By the Lines B I, C I, and D I, bisect the three Angles, which Lines will all meet in the Point I; by which Lines the given Triangle is divided into three new Angles C B I, D C I, and B D I; the Perpendiculars of which new Triangles, are the Lines A I, E I and O I, being all equal to one another; because the Point I is the Centre of the inscrib'd Circle, (by *Euclid. Lib. IV. Prop. 4.*) wherefore to the Side B C, join C F equal to D E or D O; so shall B F be equal to half the Sum of the Sides. *viz.* $= \frac{1}{2} B C + \frac{1}{2} B D + \frac{1}{2} C D$.

And $B A = B F - C D$, for $C A = C O$ and $O D = C F$ therefore $C D = A F$ and $A C = B F - B D$ for $B E = B A$ and $E D = C F$: Therefore $B D = B A + C F$ and $C F = B F - B C$.

Then make $C K = C F$ and draw the Perpendiculars F H, G H, and K H, and extend B I to H; because the Angles F C K more F H K are equal to two Right Angles (for the Angles F and K are Right Angles) equal also to $F C K + A C O$ (by *Euclid 1. 13.*)

And the Angles $A C O + A I O$ are equal to two Right Angles; therefore the Qua-

drangles F C K H, and A I O C are alike; and the Triangles C F H, and A I C are also similar; and the Triangles B A I, and B F H are also similar.

From this Explanation it appears that the Square of the Area of the given Triangle will be $B F q \times I A q = B F \times B A \times C A \times C F$. In Words

The Square of B F (the half Sum of the Sides) multiply'd into the Square of I A ($= I F = I O$) will be equal to the said half Sum multiply'd into all the three Differences.

For $I A : B A :: F H : B F$, and $I A : C F :: A C : F H$; because the Triangles are similar. By *Euclid, Lib. VI. Prop. 4.*

Wherefore multiplying the Extreams and Means in both, it will be $I A q \times B F \times F H = B A \times C A \times C F \times F H$; but F H being on both Sides of the Equation, it may be rejected; and then multiply each Part by $B F q \times I A q = B F \times B A \times C A \times C F$: which was to be demonstrated. See the *Plate. 1*

TRIANGULAR *Compasses* are such as have three Legs or Feet, whereby to take off any Triangle at once.

TRIANGULAR *Numbers* are a kind of Polygonous Numbers; being the Sums of Arithmetical Progressions, the Difference of whole Terms is 1: thus

1	2	3	4	5	6
1	3	6	10	15	21

TRIDENT [with *Mathematicians*] is us'd for a kind of Parabola, by which *Cartes* constructed Equations of six Dimensions.

TRIGLYPHS [in *Architecture*] a Sort of Ornament repeated at equal Intervals in the *Doric* Freeze; or they are a kind of Steps (in the *Doric* Freeze) between the Metopes.

TRIGLYPHS. The ordinary Proportion of them is one Module in Breadth, and one and a half in Height. But in Regard these Measures occasion a Disproportion in the Intercolumniations of Portico's (a thing particularly observable in *Vignola*, who makes the Pillars there five Modules broad.) M. *Le Clerc* accommodates the Proportion of his, *i. e.* the Triglyphs, to that of the Intercolumniations; thinking it more reasonable to make the little Parts correspond to the greater, than the greater to the less; and yet is of Opinion, that his Triglyphs, tho' different from the ordinary ones, are not inferior to them in Beauty.

When the *Triglyphs* and *Metopes* follow each other regularly, the Columns must only stand one by one; excepting those of the inner Angles, which ought always to be accompanied with two others, one on each Side; from which the rest of the Columns may be plac'd at equal Distances from each other; and it is to be observ'd, that these two Columns, which accompany that of the Angle, are not less necessary, on Account of the Solidity of the Building, than of the regularity of the Intercolumniations.

TRIGON [in *Geometry*] a Triangle.

TRIGONOMETRY, is the Art of finding the Dimensions of the Parts of the Triangle unknown, from other Parts known: Or it is the Art whereby from any 3 Parts of a Triangle given, to find the three other Parts.

Plain TRIGONOMETRY, is the Art whereby, from any three given Parts of a plain Triangle, we find all the rest.

Thus, *e. g.* from two Sides *A B* and *A C*, and an Angle *B*, we find by TRIGONOMETRY, the other Angles *B* and *C*, with the third Side *B C*. Plate, Fig. 1.

A Chord of an Arch or Angle, is a right Line *A B*, dividing the whole Circle into two Parts, and subtends both Segments. Fig. 2.

Hence, the greatest Chord that can be drawn in a Circle, is the Diameter.

Hence also, all the Chords of Arches, greater than a Semi-circle, are less than the Diameter.

A right Sine *A D*, of the Arch *A E* or *A I*, is one half of the Chord *A B* of the double Arch *A E B* or *A I B*.

Hence, the Sine *A D* is perpendicular to the Radius *E C*, consequently, all Sines standing upon the same Radius, are parallel between themselves.

A whole Sine, is the Radius *H C*, or the Sine of the Quadrant *H E*.

A versed Sine, is that Part of the Radius *E D*, or *D I*, intercepted betwixt the right Sine *A D*, and the Arch *A E* or *A I*.

Hence, the greatest versed Sine, is the Diameter *E I*.

Since

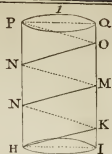
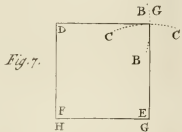
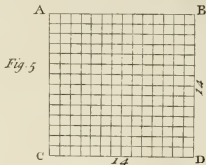
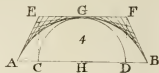
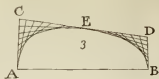


Plate XXVIII





Since that the Arch AE is the Measure of the Angle ACE , and AI is the Measure of its contiguous Angle ACI ; but the Quadrant HE is the Measure of a Right Angle; AD will also be the right Sine, and ED the versed Sine of the Angles ACE and ACI ; but the whole Sine is the Sine of a right Angle.

Therefore two Angles, which are adjacent, have the same Sine. Likewise obtuse Angles have the same Sines, which their Complements have to two right ones.

A Tangent of an Arch AE is a right Line, EF touching the Circumference of the Circle, and is at right Angles to the Diameter EI , and limited by FC , called the Secant of the same Arch.

FE is also the Tangent, and FC the Secant of the Angle ACE , and also of the Angle ACI .

Therefore two adjacent Angles have the same Tangent and Secant.

The Cosine, is the Sine AG , the Cotangent FH is the Tangent, and the Cosecant FC is the Secant of the Arch AH , which is the Complement of the other Arch AE to a Quadrant.

The Complement of an Arch or Angle, is what it wants of a Quadrant, a Semicircle, or of a whole Circle. Thus 20 Degrees is the Complement of 70 Degrees to a Quadrant; because 20 Degrees is the Remainder of 70 Degrees subtracted from 90 Degrees: Also, 50 Degrees

is the Complement of 130 to 180 Degrees, and 70 the Complement of 290 to 360 Degrees.

The Radius CA , with the Sine AD and Cosine DC , make a Triangle CAD , similar to the Triangle CFE made by the Radius CE , Tangent EF , and Secant CF . Likewise the Radius, Cotangent and Cosecant, make another Triangle, similar to the two former.

Hence as the Cosine is to the Sine, so is the Radius to the Tangent. That is, as $CD : A :: CA : EF$.

As the Radius is to the Sine, so is the Secant to the Tangent. That is, as $CA : AD :: CF : FE$.

As the Sine is to the Radius, so is the Radius to the Cosecant. That is, as $DA : CA :: HC : CF$.

As the Tangent is to the Radius, so is the Radius to the Cotangent. That is, as $FE : EC :: CH : FH$.

Therefore the Rectangle, between the Tangent and Cotangent of any Arch, is equal to the Square of the Radius.

When a Triangle is given to be resolv'd, first, we are to consider, that there is in the Table of *Logarithms*, Sines, Tangents, and Secants, a Triangle exactly similar and equal to that which is to be solved, and whose Sides are to one another in the same Proportion of those of the Triangles proposed.

Next, we must understand whatever Ratio one Side of the given Triangle has to the other Side about the same Angle, confi-

considered as Lengths, estimated or numbred by any known Measure: As suppose, Inches, Yards, Miles, &c. the very same has the two Sides about the same Angle, in the Triangles in the Tables, or in the tabular Parts; which two things, well understood, will lead us into the whole Mystery of Trigonometrical Calculations.

In estimating the Quantity of Sines, &c. we assume Radius for Unity; and determine the Quantity of Sines, Tangents and Secants in Fractions thereof. From Ptolomy's Almagest, we learn, that the Ancients divided the Radius into 60 Parts, which they called Degrees; and thence determined the Chords in Minutes, Seconds and Thirds; that is, in sexagesimal Fractions of the Radius, which they likewise used in resolving Triangles. The Sines or half Chords, were first used by the Saracens. Regiomontanus, first, with the Ancients, divided the Radius into sixty Degrees, and determined the Sines of several Degrees in decimal Fractions thereof. But he afterwards found it would be more commodious to assume Radius for one; and thus introduced the present Method into Trigonometry. In common Tables of Sines and Tangents, the Radius is supposed to be divided into 10,000,000 Parts, beyond which we never go in determining the Quantity of Sines and Tangents. Hence, as the Sine of a Hexagon subtends the sixth Part of a Circle, and is equal to the Radius, the Sine of 30 Degrees, is 5,000,000.

TRIGONOMETRICAL PROBLEMS.

PROB. I.

The Sine A D being given, to find the Cosine, or Sine Complement, A G. See Pl. Fig. 2.

Because that E C, the Sine of the same Arch E H, is perpendicular to H C and A G; the Sine of the Arch A H is perpendicular to the same H C; A G will be parallel to D C, and the Angle A G C a right Angle, and so A G C will be a right angled Triangle. Wherefore, seeing A D and H C are perpendicular to E C; G C will be equal to A D. If therefore from the Square of the Radius A C be subtracted the Square of the Sine A D, or G C, the Remainder will be the Square of the Cosine A G. Whence if the square Root be extracted, it will give the Cosine A G. *e. g.* Let A C be 10,000,000, A D 5,000,000, A G will be 8,660,254, the Sine of 60 Degrees.

PROB. II.

The Sine A D of the Arch A E being given, to find the Sine of half that Arch. Fig. 2.

Find the Chord of the Arch A E; for half of this is its Sine. Thus, *e. g.* D G and A D, as in the preceeding Problem, we shall find the Sine of half the Arch A E, or the Sine of 15 Degrees = 2,588,190.

PROB. III.

The Sine D G of the Arch D F

D F being given, to find the Sine D E of the double Arch D B. Fig. 3.

Since the Angles at E and G are right Angles, and the Angle B is common to both Triangles, BCG and DEB; $BC : CG :: BD : DE$. Wherefore CG being found by the second Problem, and BD being double of DG; DE is found by the Rule of Proportion.

Hence, $CB : 2 CG :: BD : 2 DE$, that is, the Radius is double to the Cosine of one half of the Arch D B, as the Subtense of the Arch D B is to the Subtense of double the Arch. Also, as $CB : 2 CG :: 1 : 2 BG : 2 DE :: 1 BG : DE :: \frac{1}{2} CB : CG$. Wherefore, the Sine of any Arch, and the Sine of its Double being given, the Cosine of the Arch itself is given.

PROB. IV.

The Sines FG and DE of the Arches FA and DA, whose Difference DF is not greater than 45 Minutes, being given, to find any intermediate Sine, as I L. Fig. 4.

To the Difference FD of the Arches, whose Sines are given; the Difference of the Arch IF, whose Sine is required, and the Difference of the given Sines D H, find a fourth Proportional: This added to the less given Sine FG, the Aggregate will be the Sine required.

PROB. V.

The Sines B D and E F of the

two Arches A B and A F, being given, to find the Sine B F of the Arch of half the Difference.

Subtract the lesser Sine B D from the greater E F, and the Remainder will be F K. From the given Sines B D and E F, find the Cosines B I and F H, by Problem I, subtract the lesser Cosine F H from the greater B I, the Difference will be B K. Extract the square Root from the Sum of the Difference of the Squares, the Remainder will be B F, the half of which is the Sine sought.

PROB. VI.

To find the Sine of 45 Degrees. Fig. 2.

Let H I be a Quadrant of the Circle, then will H C I be a Right Angle; consequently the Triangle, rectangular: Therefore $HI^2 = HC^2 + CI^2 = HC^2$; wherefore, since H C the whole Sine, is 10,000,000; if from $2 HC^2$ squared 200,000.000,000,000 be extracted, the square Root 14,142,136, the Chord H I will be the Remainder, whose half 7,071,068, the Sine of 45 Degrees required.

THEOREM VII.

In small Arches, the Sines and Tangents of the same Arches are nearly to one another, in a Ratio of Equality. Fig. 5.

The Triangles C E D and C B G being equiangular, $CE : CB :: ED : BG$; but as the Point E approaches B, E B will vanish in respect of the Arch B D.

B D. Whence CE will become nearly equal to C B. and so ED will also be nearly equal to EG. If EB be less than the $\frac{1}{1000000}$ of the Radius, then the Difference between the Sine and the Tangent will also be less than the $\frac{1}{1000000}$ Part of the Tangent.

Since any Arch is less than the Tangent, and greater than its Sine, and the Sine and Tangent of a very small Arch, are nearly equal, it follows, that the Arch will be nearly equal to its Sine; and so in very small Arches it will be, as Arch is to Arch, so is Sine to Sine.

PROB. VIII.

The Sine of one Minute or 60" FG being given, to find the Sine of one or more Seconds MN. Fig. 4.

Since the Arches AM and AF are very small, AMF may be taken for a right Line, without any sensible Error in the Decimal Fractions of the Radius, wherein the Sine is expressed; that is, the Arches AM and AF, may be taken proportional to their Chords. Wherefore, since MN is parallel to FG: $AF : FG :: AM : MN$. Therefore AF, FG and AM being given, MN is easily had.

PROB. IX.

To find the Sine of the Arch of one Minute.

The Subtense of 60 Degrees is equal to the Radius, so the half of the Radius will be the Sine of the Arch of 30 Degrees.

Wherefore, the Sine of the Arch of 30 Degrees being given, the Sine of the Arch of 15 Degrees may be found (by Prob. II.) and so on till twelve Bisections being made, we come to an Arch of 52° , 43° , 03° , 45° , whose Cosine is near equal to the Radius, in which Case the Arches are proportional to their Sines: And so, as the Arch 52° , 43° , 03° , 45° , is to an Arch of one Minute, so shall the Sine before found, be to the Sine of one Minute; and when the Sine of one Minute is found, then the Sine and Cosine of two Minutes will be had.

PROB. X.

The Sine AD of the Arch AE, being given, to find the Tangent EF, and the Secant FC of the same Arch. Fig. 2.

Because the Sine AD, and Tangent EF are perpendicular to the Radius EC, AD will be parallel to EF: Wherefore, as the Cosine DC is to the Sine AD, so is the whole Sine to the Tangent EF: Also, as the Cosine DC is to the whole Sine AC, so is the whole Sine EC to the Secant CF.

PROB. XI.

To construct a Canon of Sines.

The Sines of 30° , 15° , 45° and 36° , (which we have already shewn how to find) being had, we can thence construct a Canon of all the Sines to every Minute, or even a Second. For from the Sine of 36° , we find those of 18° , 9° , 4° 30 and 2° 15 (by

(by Prob. II.) the Sines of 54° , 72° , 81° , $85^{\circ} 30$ and $87^{\circ} 45$, &c. (by Prob. I.) Again, for the Sine of 45° find the Sine $22^{\circ} 30$, $11^{\circ} 15$, &c. From the Sines of 30° and the Sines of 54° find the Sine of 12° . From the Sine of 12° , find the Sines of 6° , 3° , $1^{\circ} 30$, $45^{\circ} 78^{\circ}$, &c. From the Sine of 15° find the Sine of $7^{\circ} 30$, $30^{\circ} 45$, &c. till you have 120 Sines, succeeding each other orderly at an Interval of 45 Minutes. Between these find the intermediate Sines (by Prob. V.) Thus will the Canon be compleat.

PROB. XII.

To find the Logarithms of any given Number.

The first Page of the annexed *Tables of Logarithms* contains all the natural Numbers in their proper Order, from 1 to 100. And against every one of these Numbers, is plac'd its *Logarithm*, with its *Index* before it.---Thus against the Number 28, its Log. is 1.447158; and against the Number 89, its Log. is 1.949390: and so on for the rest. In the first Column of all the following Pages, under *Num.* the natural Numbers proceed in their due Order, from 100 to 1000. And in the next Column, under 0, against every one of these Numbers, is the decimal Part of its Logarithm, without any Index; to which its proper Index must be prefixed, according as the natural Number used requires, e. g. against the Number 856, under 0, is 932474; to which

if 2 the Index of 856 be prefixed, it will be 2.932474, the compleat Logarithm of 856.

The other five Columns of each Page, contain the Logarithms of all Numbers, from 1000 to 10000. Those in the Left-hand Pages are distinguished on the Top of the Columns with the Figures 0.1.2.3.4, and those in the Right-hand Pages with 5.6.7.8.9. So that to find the Logarithm of any Number between 1,000 and 10,000, as suppose of 5.468 seek for the three first Figures, viz. 546, in the first Column under *Num.* and for the last Figure, viz. 8, at the Top. Then in the Column under the last Figure 8, and over against the three first Figures 546, there is 737829; to which if 3, the Index of 5.468, be prefixed, the compleat Logarithm thereof will be 3.737829; and so for any other Logarithm of any proposed Number, not exceeding 10,000. But if the proposed Number be above 10,000, which is the Limits of the annexed Table, then the Logarithm of that Number must be found, by the Help of the common Difference of the Logarithms, which is the last Column of every Page under *Diff.* Thus:

Find the Logarithms of the first four Figures of the given Number, without its Index, as above; and multiply the common Difference which stands against the Logarithm, under Diff. with the other Figures of the given Number, casting off so many Figures of that Product

as there are in the Multiplicator; then add the remaining Figures of that Product to the Logarithm of the first four Figures, and to their Sum prefix the proper Index; and you will have the compleat Logarithm required.

Suppose it were required to find the Logarithm of 698,476. First, the Logarithm of 6,984 is found in the Table, as above, to be 844,104 and against it, under *Diff.* is 62. This 62 being multiplied with 76, the other two Figures of the given Number, produces 4.712. Cut off 12, *viz.* the two last Figures, and then add 47 to the Logarithm last found, and the Sum will be 844,151; to which prefixing 5, the proper Index of the given Number 698,476, it will be 5.844,151, the Logarithm required.

PROB. XIII.

To find the Number to any given Logarithm.

Omit the Index of the given Logarithm, and then seek it in the Table of Logarithms, and if exactly found there, then the Number in the first Column under *Num.* with that on the Top, over Logarithm, will be the Number required. But if the given Logarithm without its Index, cannot be exactly found in the Table, then the proper Number agreeing to that Logarithm may be found by the Help of the common Difference of Logarithms: Thus:

From the given Logarithm

subtract the next less, and to the Remainder annex Cyphers; then divide it by the common Difference found against the next Logarithm, under Diff: and the Quotient will be a Number that must be annex'd to the Number already found against the next less Logarithm, according as the Index of the given Logarithm denotes.

Suppose, 5.660279 were a given Logarithm, and it were required to find the natural Number answering it.

The Number sought, must consist of six Places of Figures in whole Numbers, as appears by its Index 5; which being omitted, seek in the Table of Logarithms for 660279; but not finding it exactly there, take the next less to it, *viz.* 660201 standing under 3. and against 547: Therefore the first four Figures of the Number sought must be 4,573, and the common Difference found against 660201, under *Diff.* is 95.

Then for the Logarithm 660279
Subtr. the next less, *viz.* 660201

—————
Remains 78

To which annex two Cyphers, because there is yet wanting two Places of Figures, and it will be 7,800, which being divided by the common Difference 95, the Quotient will be 82, which must be annexed to 4,573, and the Sum will be 4,573, 382, the Number answering to the given Logarithm 5.660279. Thus the Logarithm of any given Number may

may be easily found, altho' it exceeds the Limits of the Table by 1,203 Places of Figures, and also the Number agreeing to any given Logarithm, without the Help of such a Table of proportional Parts, as is usually inserted along with the Table of Logarithms for that Purpose.

PROB. XIV.

Having given a short Description of Sines, Tangents, &c. we shall here shew the Geometrical Construction of those and other Scales commonly used in projecting the Sphere in Plano and in Trigonometry, Navigation, Dialling, and other Parts of practical Mathematicks, as they are deduced from a Circle. *Fig. 6.*

Upon a Sheet of fine Pasteboard, or such like Matter, describe a Circle *ABDC* with any Radius, which crosses at right Angles with the Diameters *AB* and *CD*; then continue *AD* to *G*, and upon the Point *B* raise *BF* perpendicular to *CB*. Draw the Chord *AB*, and divide the Quadrant *AB* into nine equal Parts, setting the Figures 10, 20, 30, &c. to 90; each of which nine Parts again subdivide into 10 equal Parts, and then the Quadrant will be divided into 90 Degrees. Set one Foot of the Compasses in the Point *A*, transfer the said Divisions to the Chord Line *AB*, and set thereto the Figures 10, 20, 30, &c. and the Line of Chords *AB* will be divided.

To project the *Sines*, divide the Arch *BD* into 90 Degrees; from each of which Degrees, let fall Perpendiculars on the Semi-Diameter *EB*, which Perpendiculars will divide *EB* into a Line of Sines, to which set the Numbers 10, 20, &c.

To project the *Line of Tangents*, from the Centre *E*, and thro' every Division of the Arch *BD*, draw the right Lines cutting *BF*, which will divide it into a Line of Tangents, set thereto the Numbers 10, 20, &c.

To project the *Line of Secants*, transfer the Distances *E 10*, *E 20*, &c. from the Tangent Line, upon the Line *EG*, and set thereto the Numbers 10, 20, &c. The Line *EG* will be divided into Line of Secants.

To project the *Semi-tangents*, draw Lines from the Point *C* thro' every Degree of a Quadrant *AB*, and they will divide the Semi-diameter *AE* into a Line of Semi-tangents; but because the Semi-tangents on Scales run to 160 Degrees, continue the Line *AE*, and draw Lines from the Point *C* thro' the Degrees of the Quadrant *CA*, cutting *AE*, and you will have the Line of Semi-tangents to 160 Degrees, &c.

To project the *Rhumb line*, from every eighth Part of the Quadrant *AC*, set one Foot of the Compasses in *A*, describe an Arch cutting the Chord *AC*, which will divide *AC* into a Line of whole Rhumbs.

To project the *Line of Longitude*, draw *HD* equal and parallel to the Radius *CE*, which divide

divide into 60 equal Parts, every 10 of which, number. Now from every one of these Parts let fall Perpendiculars to CE, cutting the Arch CD; and having drawn the Chord CD, with one Foot of the Compasses in D, transfer the Distances from D to each of the Points in the Arch CD on the Chord CD, and set thereto the Numbers 10, 20, &c. and the Line of Longitude will be divided.

These are all the Lines commonly put upon one Side of the Plain Scale, except equal Parts, which want no Description: And on the other Side is a Decimal or Diagonal Scale, on which an Inch, or some Part thereof, as $\frac{1}{2}$ or $\frac{1}{4}$ is divided into 100 equal Parts, by Diagonals.

Of the Uses of the Chords, Sines and Tangents, &c. upon the Rule.

The Chords are to lay off the Quantity of an Angle desired upon a given Point in a right Line, and to measure the Quantity of an Angle already laid down. The first is done, by taking the Extent of 60 Degrees of Chords between the Compasses, and describing an Arch about the angular Point; then laying off the Number of Degrees proposed, upon the said Arch, and drawing a right Line from the angular Point. And the latter, by making an Arch of 60 Degrees of Chords about the angular Points, and then taking the Chord of the said Arch, between the Compasses, and measuring it on the Line of Chords.

Example. To make an Angle of 30 Degrees on the Point A, Take 60 Degrees of Chords in the Compasses, and setting one Foot in A, describe the Arch DC; then take off 30 Degrees from the Chords, lay them off from D to C, and draw the Line AC. The Angle CAB will be 30 Degrees, *Fig. 7.*

To measure an Angle, suppose CAB. Take 60 Degrees of Chords, between the Compasses, and casting one Foot in A, describe the Arch CD; then take the Distance from C to D; which, measured on the Chords, will reach to 30 Degrees, the Quantity of the Angle sought.

The Sines are to project the Sphere orthographically, &c.

The Tangents, Half-Tangents and Secants, are used in finding the Centers and Poles of projected Circles in the Stereographical Projection of the Sphere, &c.

The Rhumbs, are to lay down the Angles of a Ship's Way in Navigation.

And the Line of Longitude determines, by Inspection, how many Miles there are in a Degree of Longitude, in each several Latitude, as in the Latitude of no Degrees, that is under the Equator, 60 Miles make a Degree; in the Latitude of 40 Degrees, 46 Miles make a Degree, in the Latitude of 60 Degrees, 30 Miles make a Degree; in the Latitude of 80 Degrees, 10 Miles make a Degree.

Having thus laid the Foundation, we shall next shew the Resolution of all right lined Tri-

Fig 1.

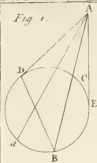


Fig 2



Fig 3



Fig 4 Plan



Fig 5

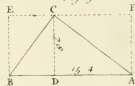


Fig 6

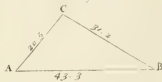
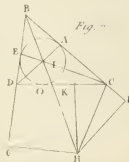


Fig 7



Triangles in as plain and familiar Method as possible.

Of resolving TRIANGLES.

THEOREM I.

In any right-angled Triangle if either of the Legs be made Radius, the other Leg will be the Tangent of its opposite Angle, *e. g.* If AD be made Radius, BD will be Tangent of the Arch $d D = BAD$; and if BD be made Radius, AD will be Tangent of the Angle B. But if the Hypotenuse AB be made Radius, the Legs BD and DA will be the Sines of their opposite Angles A and B. *Fig. 8.*

THEOREM II.

The Sides of every right-lined Triangle are in proportion to one another, as the Sines of their opposite Angles.

In the Triangle ABC make $AF = BC$, and let fall the Perpendiculars from F and B to the Side AC, describe the Arches HB and FI. Then BD will be the Sine of the Angle at C, and FE the Sine of the Angle at A, and the Triangles ABD and AFE are similar. Therefore, $AF : AB :: FE : BD$, or as $AB : BD :: AF : FE$, and AF being equal to BC, and the two Perpendiculars being Sines, it will be, as the Side BC : Side BA :: Sine of the Angle A : Sine of the Angle C; as the Side AB : Sine of the Angle C :: Side BC : Sine of the Angle A. *Fig. 9.*

THEOREM III.

As the Sum of the Legs about an Angle, is to their Difference;

so is the Tangent of half the

Sum of the opposite Angles, to the Tangent of half their Difference.

Produce, in the Triangle CFD, the Side FD, and make $BF = CF$; then BD will be the Sum of the Legs, and GD half the Sum; if you take from which the Leg FD, the Remainder $GF = \frac{1}{2}$ the Difference of the Legs; draw CB and bisect it in A, and draw AF, which will be perpendicular to it, and the Angle CAF = the Angle BFA, (by Prop. 8. *Euclid. l. 1.*) but the Angle CFB = the Angle FCD \div the Angle D: (by Prop. 32. *Euclid. l. 1.*) Therefore the Angle CFA = $\frac{1}{2}$ the Sum of the Angles FCD \div D; draw AG, which will be parallel to CD, because the Sides CB and BD are bisected in A and G; then draw EF parallel to CD, which will be parallel to AG; the Angle CFE = the alternate Angle FCD, the lesser Angle of the Triangle, because the Angle CFE = the Angles C \div D and EFB = the Angle D, take from both the Angle D, then CFE = the Angle C, which taken from the Angle CFA = $\frac{1}{2}$ the Sum of the opposite Angles, leaves EFA = $\frac{1}{2}$ the Difference of the opposite Angles. Now make AF Radius of a Circle, then EA is the Tangent of half the Difference, and AC the Tangent of half the Sum of the opposite Angles: and the Triangles BAG, BEF and BCD are similar, (by Prop. 2. *Euclid. l. 6.*) and consequently the Sides are proportional. Therefore,

$$\begin{aligned} BG : GD :: BA : AC \\ BG : GF :: BA : AE \end{aligned}$$

Therefore, as GD, half the Sum of the Sides, is to GF Half their Difference; so is AC, the Tangent of half the Sum of the opposite Angles, to AE the Tangent of half their Difference.

But the Wholes are as their Halves: Therefore the Sum of the Sides is to their Difference, as the Tangent of half the Sum of the opposite Angles, is to the Tangent of half their Difference. *Fig. 10.*

THEOREM IV.

In any Triangle whatsoever, as ACB, the Square of the Side AB opposite to an acute Angle C, is exceeded by the Squares of the other Sides, AC and CB by the Rectangle BCF twice taken; which Rectangle is contained under BC, one of the Sides comprehending the acute Angle C and the Line FC, intercepted between the Perpendiculars AF, let fall upon the Side BC from its opposite Angle A, and the acute Angle C.

The Square of $BC = 2$ Rectangles BFC and $FC + FB^2$. And $AC^2 = CF + FA^2$ (by Prop. 47. *Euclid. l. 1.*) Wherefore, $BC^2 + AC^2 = 2 BFC^2 + BF^2 + 2 FC^2 + AF^2$. But $2 BFC + 2 FC^2 = 2 BCF$. Therefore this being substituted for them; $BC^2 + AC^2 = 2 BCF + BF^2 + AF$. But $AF^2 + BF^2 = AB^2$ (by Prop. 47. *Euclid, l. 1.*) Therefore this being substituted for them,

$$BC^2 + AC^2 = 2 BCF + AB^2.$$

That is, $BC^2 + AC^2$ exceed AB^2 by $2 BCF$. *Fig. 11.*

The Theorem is true, altho' the Perpendicular fall without the Triangle. And the Demonstration is almost the same. For $AC^2 = BA^2 + CB^2 + 2 CBF$. Add on both Sides, CB^2 , then $AC^2 + CB^2 = AB^2 + CB^2 + 2 CBF = AB^2 + 2 BCF$. *Fig. 12.*

From this Theorem, and the 47th Prop. Euclid. l. 1. we have the Measure of any Triangle whatsoever, whose three Sides are known, altho' the Area be altogether inaccessible. For by the Help of these Theorems the Perpendicular is known, altho' the Impediments of the Place should not allow us to mark it out. But note, That the Perpendicular, multiplied by half the Side on which it falls, produces the Area of the Triangle.

*Let there be any Triangle, as ABC, having its Sides known. It is required, to find the Perpendicular AF falling from the Angle A upon the opposite Side BC. Take the Square of the Side AB, opposite to the acute Angle C, out of the Sum of the Squares AC and BC: By the last Theorem, the Remainder shall be the Rectangle BCF twice taken. Divide half of the Remainder, that is, the Rectangle BCF, by the known Side BC; thence will arise the right Line CF. Take the Square of the Line CF, out of the Square of AC: The Remainder will give the Square of AF, whose square Root will give the Perpendicular AF. *Fig. 12.* CASE*

CASE I.

The two acute Angles B and C, and the Base BA, being given, to find the Perpendicular CA.

1. By making the Hypothenufe BC Radius.

As the Sine of the Angle C at the Perpendicular	56° 15'	9.9198464
Is to the Base AB	121.394	2.0841992
So is the Sine of the Angle B at the Base	33° 45'	9.7447390
		<hr/>
		11.8289382
		<hr/>
To the Perpendicular AC	81.113	1.9090918

2. By making the Base AB Radius. *Fig. 13.*

As Radius AB	45°	10.0000000
Is to the Base BA	121.394	2.0841992
So is the Tangent of the Angle B	33° 45'	9.8248926
		<hr/>
To the Perpendicular AC	81.113	1.9090918

3. By making the Perpendicular AC Radius. *Fig. 14.*

As the Tangent BA of the Angle C at the Per-	pendicular 56° 15'	10.1751074
Is to the Radius AC	45°	10.0000000
So is the Base AB	121.394	2.0821992
		<hr/>
To the Perpendicular AC	81.113	1.9090918

In making the Proportions for finding the Sides or Angles of a plain Triangle, it must be observed, that every Side of a plain Triangle has two Names, and that each Side has one of those Names fixed, *viz.* the *Hypothenufe*, the *Perpendicular* and *Base*. The other Names are precarious, according to the Side made Radius, and are called the Words on the several Sides: Thus, when the Hypothenufe is made Radius, then the Word on the Hypothenufe is Radius, and the Word on the Base is the Sine of its opposite Angle; as also, the Word

on the Perpendicular is the Sine of its opposite Angle; but when the Perpendicular is made Radius, then the Word on the Base is the Tangent of its opposite Angle, and the Word on the Hypothenufe is the Secant of the same Angle; and when the Base is made Radius, then the Word on the Perpendicular is the Tangent of its opposite Angle, and the Word on the Hypothenufe is the Secant of that Angle. These Things being observed, the Way to form a Proportion to find the Side of a Triangle, is thus:

First, Suppose one Side of a
Z 2 Trian-

Triangle to be made Radius, and observe, as above, the Word on the several Sides, the Proportion will be,

As the Word on the Side given,
Is to the given Side;

So is the Word on the Side
required,

To the Side required.

Thus we see that what is sought must always stand in the fourth or last Place, and therefore, since the Perpendicular is sought, that must be the last of the four Terms; place it then with a Point of Interrogation after it, to shew it is required.

In the Rule of Proportion, the second and fourth Term being always of the same Nature, and the Perpendicular being a Length sought, and the Base the only Length given, the Base therefore must be in the second Place, and is to be wrote with four Points after it thus :: to shew that the Proportion disjoins there.

Again, we are here to observe, that the Nature of Logarithms, or their Proportion to one another, is such, that Addition serves instead of Multiplication, and Subtraction for Division; therefore the Logarithms of the two last Terms being added together, and from the Sum, the Logarithm of the first Term being subtracted, the Remainder 1.9090918 will be the Logarithm of the fourth Term, and the Number answering to that Logarithm is 81.113, which is the Perpendicular AC required.

But where Radius is not in Proportion, it may be more

readily done by Addition only; for, if instead of the first Term you set its arithmetical Complement, that is, to write down what each Figure wants of 9; thus the arithmetical Complement of 99198464, the first Term is 0.0801536, which is the same as subtracting it from 10, then add all the three Terms together, the Sum, abating the Radius, shall answer the Question.

2. To do the same by *Scale* and *Compasses*. Always extend the Compasses from the first Term to the Term that is of the same Kind, whether it be the second or third, that Extent will reach from the remaining Term to the Answer. Thus, in the first Proportion, extend the Compasses from $56^{\circ}15'$ to $33^{\circ}45'$ in the Line of Sines; that Extent will reach in the Line of Numbers from 121.39 to 81.11 the Answer. In the second Proportion, extend the Compasses from 45° to $33^{\circ}45'$ in the Line of Tangents; that Extent will reach from 121.39 to 81.11 in the Line of Numbers. In some Cases it may be needful to use Cross-work, that is, to extend from the first Term in the Line of Sines, to the second in the Line of Numbers, or from the first Term in Tangents, to the second in Numbers, &c. But in most Cases it is better to work by the Directions above, except when the Extent is too large for the Compasses.

3. By the *Sliding Rule*. Suppose the Line of Sines on the Rule to be marked with SS, and

and the Line of Sines on the Slider with S. Then the first Proportion will be thus wrought.

Set $33^{\circ}45'$ on S to $56^{\circ}15'$ on SS; then against 121.39 on A, is 81.11 on B. (A signifies the double Line of Numbers upon the Rule, and B the double Number on the Slider). The second Proportion may be thus wrought: Set $33^{\circ}45'$ in the Tangents to Radius; then against 121.39 on A, is 81.11 on B. Or, if the Slider be so turned, as the Tangents and double Numbers may slide one by another, then the Radius may be set, *viz.* 45° of Tangents to 121.39 in the Line of Numbers; then against $33^{\circ}45'$ in Tangents, is 81.11 in the Line of Numbers. The third

Proportion may be wrought as this last.

To do the same Geometrically. Draw the Base BA, and from a Diagonal Scale, or Scale of equal Parts, take with the Compasses 121.39, and set from B to A, and upon A raise a Perpendicular; then take 60° Degrees from the Line of Chords with the Compasses, and set one Foot in B, describe the Arch DE, and from the same Line of Chords $33^{\circ}45'$ and set from D to E; and draw the Line DC, till it cut the Perpendicular in C: Then if you measure AC by the same Scale you took BA from, you will find it 81.11; and if you measure BC, you will find it 146. *Fig. 15.* The next Case will be so resolved.

CASE II.

The two acute Angles B and C, and the Base BA being given, find the Hypothenuse BC. Fig. 12.

1. By making the Hypothenuse BC Radius.

As the Sine of the Angle C $56^{\circ}15'$	9.9198464
Is to the Base BA 121.394	2.0841992
So is the Radius 90°	10.0000000
<hr/>	
To the Hypothenuse BC 146	2.1643528

2. By making the Base AB Radius. *Fig. 13.*

As Radius BA	10.0000000
Is to the Base BA 121.394	2.0841992
So is the Secant of the Angle B $33^{\circ}45'$	10.0801536
<hr/>	
To the Hypothenuse BC 146	2.1643528

3. By making the Perpendicular AC Radius. *Fig. 14.*

As the Tangent of the Angle C $56^{\circ}15'$ Arith. Compl.	9.8248926
Is to the Base BA 121.394	2.0841992
So is the Secant of the Angle C	10.2552610
<hr/>	
To the Hypothenuse BC 146	2.1643528

By Scale and Compasses.

To work the first Proportion, extend the Compasses from the Sine of $56^{\circ}15'$ to 90° , which Extent will reach from 121.39 to 146 in the Line of Numbers.

By the Sliding Rule.

Set $56^{\circ}15'$ upon S to 90° upon SS, then against 121.39 upon B, is 146 upon A. But if you turn the Slider, so as the

Sines and double Numbers may slide one by another, you may set $56^{\circ}15'$ of Sines to 121.39 in the Line of Numbers: Then against 90° of Sines you will have 146 in the Line of Numbers, and will find $33^{\circ}45'$ of Sines to be against 81.11 of Numbers. So that you may observe, if 90 of Sines be set to the longest Side or Hypotenuse, you will find every Angle against its opposite Side.

C A S E III.

Two acute Angles B and C, and the Hypotenuse B C being given, to find the Base B A. Fig. 12.

1. By making the Hypotenuse B C Radius.

As Radius 90°	-	-	10 0000000
Is to the Hypotenuse B C 146			2.1643528
So is the Sine of the Angle C $56^{\circ}15'$			9.9198464
			<hr/>
To the Base B A 121.394.			2.0841992

2. By making the Base B A Radius. Fig. 13.

As the Secant of the Angle B $33^{\circ}45'$			10.0801536
Is to the Hypotenuse B C 146			2.1643528
So is the Radius 90°	-	-	10.0000000
			<hr/>
To the Base B A 121.394			2.0841992

3. By making the Perpendicular A C Radius. Fig. 14.

As the Secant of the Angle C $56^{\circ}15'$ Arith. Compl.			9.7447390
Is to the Hypotenuse B C 146			2.1643528
So is the Tangent of the Angle C $56^{\circ}15'$			10.1751074
			<hr/>
To the Base B A 121.394			2.0841992

*By Scale and Compasses.**By the Sliding Rule.*

To work the first Proportion, extend the Compasses from 90° to $56^{\circ}15'$ in the Sines, which Extent will reach from 146 to 121.394 in the Line of Numbers.

Set $56^{\circ}15'$ upon S to 90° upon S S; then against 146 upon A, is 121.394 upon B.

By Geometrical Protraction.

Draw the Line B C, and from the Scale of equal Parts take 146, and set from B to C, with 60 Degrees of Chords describe

the Arch DE, and set $56^{\circ}15'$ from E to D, and draw CA, and from B draw BA perpendicular to AC; then when AB is measured by the Scale, it will be found to contain 121.39. *Fig. 15.*

CASE IV.

The Base B A and the Perpendicular C A being given, to find the two acute Angles B and C. Fig. 13.

1. By making the Base BA Radius.

As the Base B A 121.394

Is to the Radius 45°

So is the Perpendicular A C 81.113

2.0841992

10.0000000

1.9090918

To the Tangent A C of the Angle B $33^{\circ}45'$

Whose Complement is $56^{\circ}15'$ the Angle C.

9.8248926

2. By making the Perpendicular A C Radius. *Fig. 14.*

As the Perpendicular A C 81.113

Is to the Radius $45^{\circ}15'$

So is the Base 121.394

1.9090918

10.0000000

2.0841992

To the Tangent of the Angle C $56^{\circ}15'$

Whose Complement is $33^{\circ}45'$ the Angle B.

10.1751074

By Scale and Compasses.

To work the first Proportion, extend the Compasses from 121.394 to 81.113 in the Line of Numbers, that Extent will reach from 45° to $33^{\circ}45'$ in the Tangents. For the second Proportion, extend from 18.113 to 121.394 in the Line of Numbers, that Extent will reach from 45° to $56^{\circ}15'$ in the Tangents.

By the Sliding Rule.

Let the Tangents and Numbers slide together, then set 121.394 in the Line of Numbers to 45° of Tangents, and against 81.113 in the Line of Numbers is $33^{\circ}45'$ and its Complement $56^{\circ}15'$ in the Line of Tangents.

This Case is done Geometrically, as the sixth.

C A S E V.

The Base BA and the Hypothenufe BC being given, to find the two acute Angles B and C. Fig. 12.

1. By making the Hypothenufe BC Radius.

As the Hypothenufe BC 146	2.1643528
Is to the Radius 90°	10.0000000
So is the Base BA 121.394	2.0841991

To the Sine of the Angle C $56^\circ 15'$	9.9198463
---	-----------

Whose Complement $33^\circ 45'$ is the Angle B.

2. By making the Base Radius

As the Base BA 121.394	2.0841992
Is to the Radius 90°	10.0000000
So is Hypothenufe 146	2.1643528

To the Secant of the Angle B $33^\circ 45'$	10.0801536
---	------------

By Scale and Compasses.

For the first, extend the Compasses from 146 to 121.394, in the Line of Numbers, which will reach from 90° to $56^\circ 15'$ in the Sines.

By the Sliding Rule.

Set 146 upon A to 121.394 upon B, then against Radius on SS, is $56^\circ 15'$ on S.

By Geometrical Protraction.

Draw the Base BA, and from

a Scale of equal Parts take 121.394 and set from B to A, and upon A raise the Perpendicular AC; then from the same Scale of equal Parts take 146, and set one Foot of the Compasses in B with the other cross AC in C, and draw BC. Then with 60° of Chords describe the Arch DE and measure DE with the Compasses on the Line of Chords, which will be $33^\circ 45'$ the Measure of the Angle B, whose Complement is the Angle C. Fig. 15.

C A S E VI.

The Base BA and the Perpendicular CA being given, to find the Hypothenufe BC. Fig. 16.

In this, and the next Case, we are first to find the acute Angle, and from thence the third Side.

1. The Perpendicular A C being made Radius.

As the Perpendicular C A 81.113	1.9090918
Is to the Base B A 121.394	2.0841992
So is the Radius 45°	10.0000000

To the Tangent of the Angle C $56^\circ 15'$	2.1643528
--	-----------

2. The Hypothenufe B C being made Radius.

As the Sine of the Angle C $56^\circ 15'$	9.9198464
Is to the Base B A 121.394	2.0841999
So is the Radius 90°	10.0000000

To the Hypothenufe 146	2.1643528
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*By Scale and Compaffes.**By Geometrical Protraction.*

Extend the Compaffes from 81.113 to 121.39 in the Line of Numbers, that Extent will reach from 45° to $56^\circ 15'$, in the Sign of Tangents; then extend from $56^\circ 15'$ to 90° in the Sines, that Extent will reach from 121.394 to 146.

By the Sliding Rule.

Set 81.113 in the Line of Numbers to 45° in the Tangents; then againft 121.39 in the Numbers is $56^\circ 15'$ in the Tangents; then fet $56^\circ 15'$ on S to 90° on SS; then againft 121.39 on B is 146 on A.

Draw the Line B A, and from a Scale of equal Parts take 121.394 in the Compaffes, and fet from B to A, and upon A erect the Perpendicular A C; and from the fame Scale take 81.113, and fet from A to C; then draw the Hypothenufe B C, take B C in the Compaffes, and on the Scale it will be found 146. Then with 60° of Chords describe the Arch D E. measure D E with the Compaffes on the Line of Chords, which will be $33^\circ 45'$ the Measure of the Angle B, whose Complement is the Angle C. *Fig. 15.*

C A S E VII.

The Base B A, and the Hypothenufe being given, to find the Perpendicular A C. Fig. 12.

1. The Hypothenufe B C being made Radius.

As the Hypothenufe B C 146	2.1643528
Is to the Radius 90°	10.0000000
So is the Base B A 121.394	2.0841992

To the Sine of the Angle C $56^\circ 15'$	9.9198464
Whose Complement is the Angle B $33^\circ 45'$	

2. The

2. The Hypothenufe B C being made Radius.

As Radius 90

10.0000000

Is to the Hypothenufe B C 146

2.1643528

So is the Sine of the Angle B $33^{\circ} 45'$

9.7447390

To the Perpendicular A C 81.113

1.9090918

By Scale and Compasses.

For the first Operation, extend the Compasses from 146. to 121.394 in the Line of Numbers, that Extent will reach from 90° to $33^{\circ} 45'$ in the Sines. Then for the second Operation, extend the Compasses from 90° to $33^{\circ} 45'$ in the Sines, that Extent will reach from 146 to 81.113 in the Line of Numbers.

By the Sliding Rule.

For the first, set 146 on A to 121.394 on B, then against 90 on SS there will be found

$56^{\circ} 15'$ on S. Then for the second, set 90° on SS to $33^{\circ} 45'$ on S and against 146 on A, is 81.113 on B.

By Geometrical Protraction.

Draw the Line A B, and from the Scale take 121.394, which set from B to A, and upon A raise the Perpendicular A C, then from the Scale take 146, and set one Foot of the Compasses B, cross the Perpendicular in C, and measure A C on the Scale, which will be 81.113. Fig. 15.

The Seven Cases of Plain Triangles.
See Plate, Fig. 8.

Right Angled.			
Cases.	Given.	Required.	Proportions.
I.	A B and B	A C	1. $s C : B A :: s B : A C$. 2. $R : B A :: t B : A C$. 3. $t C : B A :: R : A C$.
II.	A B and C	B C	1. $s C : B A :: R : B C$. 2. $R : B A :: s e B : B C$. 3. $t C : B A :: s e C : B C$.
III.	B C and B	B A	1. $R : B C :: s C : B A$. 2. $s e B : B C :: R : B A$. 3. $s e C : B C :: t C : B A$.
IV.	A B and A C	B and C	1. $B A : R :: A C : t B$. whose Complement is C. 2. $C A : R :: B A : t C$. whose Complement is B.
V.	B C and A C	B and C	1. $B C : R :: B A : s C$ whose Complement is B 2. $B A : R :: B C : s e B$ whose Complement is C
VI.	A B and A C	B C	1. $C A : B A :: R : t C$. Then again, 2. $s C : B A :: R : B C$.
VII.	A B and B C	A C	1. $B C : R :: B A : s C$ whose Complement is B Then again, 2. $R : B C :: B : s A C$.

§. III. Of solving Oblique Angled TRIANGLES.

C A S E I.

The Angles C A B $62^{\circ} 30'$ and C B A $37^{\circ} 30'$ and the Side A C 350 Feet being given, to find the other two Sides C B and A B. Fig. 17.

As the Sine of the Angle C B A $37^{\circ} 30'$ Arith.	}	0.2155529
Compl.		
Is to the Side A C 350.		2.5440680
So is the Sine of the Angle C A B $62^{\circ} 30'$		9.9479289
		<hr/>
To the Side B C		509.976
		<hr/>
		2.7075498

For the Side A B.

As the Sine of the Angle C B A $37^{\circ} 30'$ Arith.	}	0.2155529
Compl.		
Is to the Side A C 350		2.5440680
So is the Sine of the Angle A C B 80°		9.9933515
		<hr/>
To the Side A B		566.203
		<hr/>
		2.7529724

The Parts required in the several Cases of oblique Trigonometry, may be found with the Scale and Compasses, by extending the Compasses from the first Term of the Proportion, to the second, and the same Extent will reach from the third Term to the fourth required. Also the Parts required may be found by the Sliding Rule, by setting the first Term against the second, then opposite to the third Term, the fourth Term may be found.

C A S E II.

The two Sides A C 350 and C B 509.976, and the Angle C A B $62^{\circ} 30'$ opposite to one of the given Sides, C B being given, to find the Angle C B A opposite to the other Side A C. Fig. 17.

As the Side B C 509.976 Arith. Compl,	7.2924502
Is to the Sine of the Angle A $62^{\circ} 30'$	9.9479289
So is the Side A C 350	2.5440680
<hr/>	
To the Sine of the Angle B $37^{\circ} 30'$	9.7844471

Or,

Or, if the two Sides A B and B C and the Angle opposite to the Side B C had been given, and the Angle C had been required; then,

As the Side B C 509.976 Arith. Compl.

7.2924502

to the Sine of the Angle A $62^{\circ}30'$

9.9479289

So is the Side A B 566.203

2.7529724

So the Sine of the Angle C 80°

9.9933515

C A S E III.

The Side A B 566.203, the Side A C 350, and the Angle A $62^{\circ}30'$ comprehended between the Sides A B and A C being given, to find the Angles A C B and A B C. Fig. 17.

A B = 566.203 180°

A C = 350 Subt. $62^{\circ}30'$

The Sum 916.203 Rem. 117 30 = Sum of the Angles B and C.

Diff. 216.203 $58^{\circ}45'$ = half the Sum.

As 916.203 the Sum of the Sides Arith. Compl.

7.0380083

to 216.203 the Difference of the Sides

2.3348617

So is the Tangent $58^{\circ}45'$ half the Sum of the opposite Angles

10.2169438

To the Tangent $21^{\circ}15'$ half the Difference of the opposite Angles, (by *Theor. 3. Sect. II.*)

9.5898138

If $21^{\circ}15'$ be added to $58^{\circ}45'$ the Sum will be 80° the Angle A C B; and if $21^{\circ}15'$ be subtracted from $58^{\circ}45'$, the Remainder will be $37^{\circ}30'$ the Angle A B C.

C A S E IV.

The Side A B 566.203, the Side B C 509.976 and the Angle B $37^{\circ}30'$ comprehended between the Sides A B and A C being given, to find the third Side A C. Fig. 17.

The Side A B 566.203 $180^{\circ}00'$

The Side B C 509.976 $37^{\circ}30'$

The Sum 1076.179 $142^{\circ}30'$

Difference 56.227 $71^{\circ}15'$

As 1076.179 the Sum of the Sides Arith. Compl. 6.9681154
 Is to the Difference 56.227 1.7499449
 So is the Tangent of half the Sum of the opposite } 10.4692187
 Angles

To the Tangent $8^{\circ} 45'$ half the Difference of the } 9.1871790
 opposite Angles (by *Theor. 3. Sect. II.*) }

If $8^{\circ} 45'$ be added to $71^{\circ} 15'$, the Sum will be 80° the
 greater Angle C, and being subtracted the Remainder $62^{\circ} 30'$
 the lesser Angle A. Then,

As the Sine of the Angle A $62^{\circ} 30'$ Arith Compl. 0.0520711
 Is to the Side B C 509.976 2.7075498
 So is the Sine of the Angle B $37^{\circ} 30'$ 9.7844471

To the Side A C 350, which is required (by *Case* } 2.5440680
 I. *Sect. III.* }

C A S E V.

The three Sides A B 213.5, A C 103.5, and B C 250.2 of an
 oblique Triangle A B C being given to find the three Angles.
Fig. 18.

As the greatest Side C B 250.2 Arith, Compl. 7.6017127
 Is to the Sum of the other two Sides A B and A C } 2.5065050
 321. }
 So is the Difference B E 106 of the two Sides A B } 2.0253055
 and A C. }

To the Difference B F 135.995 of the Segments } 2.1335230
 of the Base. }

Which Difference 135.995, lique Triangle is reduced into
 subtracted from B C 250.2 the two right-angled Triangles, viz
 greatest Side, leaves F C 114. A B G and A G C both right
 205, the half whereof is G C angled at G, in each of which
 57.1025 the lesser Segment; there is given the Hypothenufe
 which if subtracted from B C and Base: So the Angles may
 250.2, the Remainder B G will be found by (*Case V. Of right*
 be 193.0975, the greater Seg- angled plain Triangles) thus:
 ment of the Base. Thus the ob-

As the Hypothenufe A B 213.5 2.329397
 Is to the Radius 10.0000000
 So is the Base B G 193.0975 2.285776

To the Sine of the Angle B A G $64^{\circ} 44' 51''$ 9.956378
 The Complement of B A G is A B G $25^{\circ} 15' 9''$

Again

Again, in the Triangle A C G.

As the Hypothenuse A C 107.5

s to the Radius

So is the Base G C 57.1025

2.0314085

10.0000000

1.7566552

To the Sine of the Angle G A C $32^{\circ} 5' 8''$

The Complement of G A C is A C G $57^{\circ} 54' 52''$ 9.7252467

This Case is demonstrated from the fourth Theorem of Sect. II.

The Five Cases of oblique-angled Triangles.

See Plate, Fig. 9.

Cases.	Given.	Required.	Proportions.
I.	A C A and B	A B	$s B : A C :: s C : A B.$
II.	A C C B and B.	A	$C A : s B :: C B : s A.$
III.	A C C B and C.	A and B	$C B + C A : C B - A C :: t \frac{1}{2} A$ $+ B : t \frac{1}{2} \text{ the Difference,}$ which $\frac{1}{2}$ Dif. $\left\{ \begin{array}{l} \text{added to} \\ \text{sub. from} \end{array} \right\}$ the $\frac{1}{2}$ Sum giv. the $\left\{ \begin{array}{l} \text{greater} \\ \text{lesser} \end{array} \right\}$ Angle.
IV.	A C C B and C.	A B	Find the Angles A and B by the last Case; then, by the first Case, the Side A B will be found.
V.	A B A C and C B.	A, B and C.	$B C : A B + A C :: A B - A C :$ $B F.$ Then $B C - B F =$ $F C$ and $\frac{1}{2} F C$ is C G.

§. I. Of Trigonometrical PROBLEMS.

P R O B. I.

To measure an accessible Altitude.

Let AB represent a Tower, Steeple, &c. whose Height is required?

First, with the Quadrant, or other Instrument, find the Quantity of the Angle C, which suppose to be $52^{\circ}30'$, then measure the Distance AC; which suppose to be 85 Feet; then by Case I. of plain Triangles:

As the Sine of the Angle CBA	$37^{\circ}30'$ Arith. Compl.	0.215553
Is to the Base AC	85 Feet	1.929419
So is the Sine of the Angle C	$52^{\circ}30'$	9.899466

To the Altitude AB	110.8	2.044438
Or thus,		

As Radius		10.000000
Is to the Base AC	85	1.929419
So is the Tangent of the Angle C	$52^{\circ}30'$	10.115019

To the Altitude	110.8	2.044438
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Note, That in this, and all such Cases, you must add the Height of your Eye, or Instrument to the Altitude before found.

P R O B. II.

To measure an inaccessible Altitude.

Let AB be a Church Steeple, whose Height is required; but by reason of a River, or some other Obstacle, you cannot come to the Foot of it at A.

First, Take, with the Quadrant at C, the Angle of Altitude, which, suppose to be $26^{\circ}30'$; then measure in a right Line towards the Steeple to D, which suppose to be 75 Feet, and at D again observe the Angle of Altitude, which, let be $51^{\circ}30'$.

Now the two visual Lines C B and D B, and the measured Distance C D form the oblique angled Triangle C B D, wherein are given all the Angles, and the Side C D, the Angle B C D being $26^{\circ}30'$ and the Complement of A D B $51^{\circ}30'$ to 180 is the obtuse Angle B D C $128^{\circ}30'$, and consequently, the third Angle C B D is 25° . But this Angle may be more readily found by subtracting B C D from A D B (by Euclid. 1. 1. Prop. 32.) Then by Case I. Of oblique, angled plain Triangles, find the Side B D; Thus:

As the Sine of the Angle CBD $25^{\circ} 30'$	0.374052
Is to the Distance of CD 75	1.875067
So is the Sine of the Angle C $26^{\circ} 30'$	9.649527
<hr/>	
To the visual Line B D 79.18	1.898640

Then by Case I. *Of right-angled plain Triangles.*

As Radius	10.000000
Is to B D 79.18	1.989640
So is the Sine of the Angle ADB $51^{\circ} 32'$	9.893544
<hr/>	
To the Altitude AB 61.97.	1.729184

PROB. III.

To measure the Height of a Steeple, Tower, &c. standing upon a Hill.

First, Find the Angle CAB 44° and the Angle EAB 26° ; then measure in a strait Line A C D and the Side A D; towards the Steeple from A to D 134 Feet: Then again at D, find the Angle CDB $67^{\circ} 50'$, and the Angle EDB 51° . By Case I. *Of oblique plain Triangles*, find the visual Line CD in the Triangle A C D, wherein are given the Angles D A C and A C D and the Side A D; Thus:

As the Sine of the Angle A C D $23^{\circ} 51'$	3.393536
Is to the measured Distance A D 134	2.127105
So is the Sine of the Angle C A D 44°	9.841771
<hr/>	

To the Side C D 230.4	2.362412
-----------------------	----------

Then, as Radius	10.000000
Is to the Side C D 230.4	2.362412
So is the Sine of the Angle C D B $67^{\circ} 50'$	9.966653
<hr/>	

To the Side B C 213.3	2.329065
-----------------------	----------

Again, As Radius	10.000000
Is to the Side C D 230.4	2.362412
So is the Sine of the Angle B C D $22^{\circ} 10'$	9.576689
<hr/>	

To the Base B D 86.92	1.939101
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Lastly, As Radius	10.000000
Is to the Base B D 86.92	1.939101
So is the Tangent of the Angle B D E $51'$	10.091631
<hr/>	

To the Perpendicular B E 107.3	2.030732
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From the whole perpendicular Height B C
Subtract the Perpendicular Height of the Hill B E

213.3
107.3

There remains the Height C E of the Steeple

106

P R O B. IV.

One Side B C 532 of an oblique Triangle A B C, the Angle A $110^{\circ} 30'$ opposite to that Side, and the Sum of the other two Sides A B and A C 637 being given, to find the other two Sides and the Angles severally. See Plate, Fig. 22.

Extend the Side B A to D, make A D equal to A C and draw D C, so there will be other two oblique-angled Triangles B D C and A D C. In the Triangle A B C is given, the

Angle B A C $110^{\circ} 30'$, and in the Triangle A C D is given the Angle C A D $69^{\circ} 30'$ the Complement of the other to 180° ; also the Triangle A D C is equicrural by Construction, therefore the Angles C and D at the Base are equal, and each of them is equal to $\frac{1}{2}$ the given Angle B A C (by Prop. 32. *Euclid*. I. 1.) Now in the Triangle B C D there is given B C 532, B D 637, and the Angle B D C $55^{\circ} 15'$. Whence the Angle D C B may be found (by Case I. *Of oblique Triangles*.)

As the Side of B C 532 Arith. Comp.
Is to the Sine of the Angle B D C $55^{\circ} 15'$
So is the Side B D 637

7.2740884
9.9146852
2.8041394

To the Sine of the Angle B C D $100^{\circ} 19'$

9.9929130

From which subtract the Angle A C D $55^{\circ} 15'$, and the Remainder is $45^{\circ} 4'$ for the Angle A C B, and the Angle is $24^{\circ} 26'$, which is found by subtracting the Sum of B C D $100^{\circ} 19'$, and D $55^{\circ} 15'$ from 180° . The Sides A B and A C, are found (by Case I. *Of oblique Triangles*).

As the Sine of the Angle B A C $100^{\circ} 30'$ Arith. Compl. 0.0284124
Is to the Side B C 532 2.7259116
So is the Sine of the Angle A C B $45^{\circ} 4'$ 9.8499897

To the Side A B 402.08

2.6043187

Again, As the Sine of the Angle B A C $110^{\circ} 30'$ }
Arith. Compl. }

Is to the Side B C 532
So is the Sine of the Angle A B C $24^{\circ} 26'$

0.0284124
2.7259116
9.6166164

To the Side A C 234.93 -----

2.3709404
PROB.

P R O B. V.

One Side B C 250.2 of an oblique Triangle ABC, the Angle B A C $96^{\circ} 50'$ opposite thereto, and the Difference of B D 106, of the other two Sides A B and A C being given, to find the Angles B and C, and the two Sides severally. See Plate, Fig. 23.

Make A D equal to A C, and draw C D; the Angle D A C being $96^{\circ} 50'$, the Complement thereof to 180° is $83^{\circ} 10'$ for the two Angles A D C and A C D; which being equal one to the other, therefore each of them is half of $83^{\circ} 10'$; and by drawing C D there is also another Triangle made, wherein is given B C 250.2 and B D 106, equal to the Difference of the two Sides A B and A C; and there is also given the Angle B D C $138^{\circ} 25'$, equal to the Complement of $41^{\circ} 35'$

As the Side B C 250.2 Arith. Compl.	7.6017127
Is to the Sine of the Angle B D C $138^{\circ} 25'$	9.8219775
So is the Side B D 106	2.0253059

To the the Sine of the Angle B C D $16^{\circ} 19' 52''$	9.4489961
--	-----------

To which if A C D $41^{\circ} 35'$ be aded the Sum of the Angle A C B will be $57^{\circ} 54' 52''$: and if A be added to it, and the Sum subtracted from 180, there will remain the Angle A B C $25^{\circ} 15' 8''$. Find the Sides A B and A C, as in the last Problem; Thus:

As the Sine of the Angle B A C $96^{\circ} 50'$ Arith. Compl.	0.0030960
Is to the Side B C 250.2	2.3982873
So is the Sine of the Angle A C B $57^{\circ} 54' 52''$	9.9280146

To the Side A B 213.5	2.3293979
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Again,

As the Sine of the Angle B A C $96^{\circ} 50'$ Arith. Compl.	0.0030960
Is to the Side B C 250.2	2.3982873
So is the Sine of the Angle A B C $25^{\circ} 15' 8''$	9.6300247

To the Side A C 107.5	2.0314080
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P R O B. VI.

In the right angled Triangle A B C there are given, Base A B 40, and the Sum of the Perpendicular A C, and Hypotenuse A D 200, to find the Perpendicular A C and Hypotenuse C B severally. See Plate, Fig. 24.

In the Triangle A B D is given the Base and Perpendicular, to find the Angles A B D and A D; Thus: ;

As the Base A B 40	1.6020600
Is to the Radius 45	10.0000000
So is the Perpendicular A D 200	2.3010300
<hr/>	
To the Tangent of the Angle A B D $78^{\circ} 41' 24''$	10.6989700

Whose Complement is the Angle D $11^{\circ} 18' 36''$, and because C D is equal to C B, therefore the Angle C B D is also $11^{\circ} 18' 36''$; then if $11^{\circ} 18' 36''$ be subtracted from the whole A B D $78^{\circ} 41' 24''$ there will remain the Angle A B C $67^{\circ} 22' 48''$. Then to find the Sides.

As Radius	10.0000000
Is to the Base	1.6020600
So is the Tangent of the Angle A B C $67^{\circ} 22' 48''$	10.2802083
To the Perpendicular A C 96	1.9822683

Then subtract 96 from 200, and there will remain the Hypothenufe B C 104

P R O B. VII.

Let B E and D be three Objects, whose Distances are known, and C a Station from which all the Objects may be seen, and the Angles with each Object may be found. What is the Distance of each Object?

See Plate, Fig. 25.

B D 106, B E 53 25 D E 65,
5 the Angles B C E $13^{\circ} 30'$
and D C E $29^{\circ} 50'$ are given,
to find B C, E C and D C.

The three Angles of the Triangle B D E are found by Case V. Of oblique angled Triangles.

Thro' the three Points B, D, and C describe a Circle, draw the Lines B C, D C and E C, which last continue to F, where it cuts the Circle, draw B F and D F. Then $180 - \text{Angle B C D} = \text{Angle B F D} = 136^{\circ} 40'$ (by Prop. 32. Euclid. l. 1.) and the Angle B D F = Angle B C F (by Prop. 21. Euclid. l. 3.) and so the Angle D B F =

Angle D C F. In the Triangle B F D all the Angles are given, and the Side B D, to find B F = 26, 059 to D F = 76, 843 (by Case I. Of oblique angled Triangles.) Then the Angle F D B Angle B D E = F D E; then in the Triangle F D E, are given the Sides E D, F D, and the included Angle F D E, to find the Angle F E D = $84^{\circ} 30' 24''$ and $180 - \text{Angle F E D} = 95^{\circ} 29' 36''$; then in the Triangle E D C all the Angles, and the Side D E are given, to find E C = 107, 42 and D C = 131, 05. Lastly, In the Triangle B D C all the Angles and the two Sides B D and D C are given, to find the third Side B C 151.3.

P R O B. VIII.

Suppose B and D two Stations, whose Distance is 47.5 Yards, from whence the two Objects C and E, may be seen, and their Angles found by Observation, viz. C B E 49° , E B D 28°
C D B

C D D 32° , and C D E 56° it is required to find B C, B E, D C, D E and C E. See Plate Fig. 26.

In the Triangle C B D, the Side B D and all the Angles are given, to find B C = 28, 7795, and D C = 54, 2349, (which is done by Case I. Of oblique angled Triangles) and in the Triangle B E D are given the same Things, to find B E = 58, 6775 and D E = 36, 1475, (by the same Case.) Lastly, In the Triangle B C E are given, B C B E and the included Angle C B E to find C E = 45, 3378, (by Case IV. Of oblique angled Triangles.

PROB. IX.

Let C and E be two Objects, whose Distance is known, and let B and D represent two Stations, from whence they may be both seen, and the horizontal Angles C B E and D B E, C D E and C D B found by Observation; but the Distance of the two Stations cannot be measured, What is the Distance of the two Stations, and the Objects from each Station? See Plate, Fig. 27.

Draw another Figure c e d b, whose Side d b, suppose to be any Number, as 10, and similar to C E D B; now, upon Supposition, that b d is 10, and the small Figure similar to the great one, we can, by the last Problem, find d e = 7, 61, b e = 12, 353116, b c = 6, 05885, d c = 11, 41787, and c e = 9, 5448. Now, if by working in this Manner, c e had been found = C E = 45, 3378, then it is plain,

all the Side had been exactly found; but as it has not been found by similar Triangles, the true Sides may be found by those already discovered, thus, as, c e : C E :: c b : C B = 28, 7795; and as, c e : C E :: c d : C D; and c b : C B :: b d : B D = 47, 5; and as, c e : C E :: e d : E D = 36, 147; and so of the rest.

LOGARITHMS.

Purposing to give you the Solution of some of the Questions in this Book by those excellent Numbers the Logarithms; take these Directions for the better understanding the Nature and Use of them.

They are artificial Numbers, fitted to the natural, for the Ease of Calculation; and are printed in Tables having two Columns. One hath the natural Number; against it in the other is his Logarithms: So that the Logarithm of a whole Number is easily found.

The Tables begin at 1, whose Logarithm is 0, 00000; and reach commonly to 10, 000; consisting every one of 8 Figures, though (unless in great Numbers) we seldom use above six; (if the Figures left out exceed 50, we put an Unite to the sixth) to the Logarithms are annexed Differences; by the Help of which, and a Table of proportional Parts adjoined, you are directed to find the Logarithm of any Number to 100, 000. But these are but of 7 Places.

Mr. *Wingate*, in his *Tabula Logarithmica*, hath the Logarithms to 100,000 with Differences also; whereby making a Proportion, (which is done speedily by one Slip of this Rule) you have the Logarithms as far as 1,000,000 in a portable Volume for the Pocket. A Book which I commend to any that delight in Arithmetick.

The first Figure, called the Index, (which is commonly separated by a Point, better left out, except in the first hundred, as in the late printed Tables) shews how many Figures the answering Number, if whole, or the whole Part thereof, if it hath a Decimal annexed, consisteth of; which are always more by one than the Index. So 0, is the Index of one Figure, 1 of two Figures, 2 of three, 3 of four, &c.

Also according to the excellent Way of Mr. *Christopher Townly*, cited by Sir *Jonas Moor* in his *Mathematical Compendium*, the Log. of a Decimal is the same, as if it were a whole Number, with this Direction for the Index.

If the Decimal be of the first Rate, the Index is 9; if of the second Rate, the Index is 8; if of the third Rate, the Index is 7, &c. that is, the Index of the Logarithm of any Decimal, wants as many Units of ten, as the left Hand significant Figure is distant from Unity: Which, I hope, you will understand, if you observe this following Table.

<i>Perf. Numb.</i>	<i>Log.</i>
3536.	3.54851
353.6	2.54851
35.36	1.54851
3.536	0.54851
<i>Decimals.</i>	<i>Log.</i>
.3536	9.54851
.03536	8.54851
.003536	7.54851
.0003536	6.54851

Where you see, That in the perfect Numbers, the Index sheweth the Number of Places in the whole Numbers, and in the whole Part of the mixt, being always less by one than the said Places; but in Decimals it sheweth the Rate, being the Complement thereof to Ten, not regarding the Number of Places.

If then you would have the Log. of any Number, find the Log. thereof in the Table, as if it were whole; and prefix the Index answering the Value.

And having a Log. find the Number answering in the Table, and by a Point fix the Value according to the Index.

To find a Log. to a Number of six Places in the Tabula Logarithmica by Help of this Rule.

Call the Difference at the Bottom the Tabular Differences. Having the Log. of the five first Figures, by the double Scale on your Rule, set 10 to the Tabular Differences; against

gainst your sixth Figure is his proportional Part to be added to the Log. before found.

To find a Number of six Places answering a Log. given.

Find the Number of five Places answering the Log. in the Table, next less to the given Log. subtract the said Log. out of the given Log. call the Remainder the proper Difference; then by the double Scale on your Rule set 10 to the Tabular Difference; against the proper Difference on the second, is your sixth Figure on the first, to be annexed to the five Figures before found.

Note, That you must use all the eight Figures in these Cases.

Some Uses of the Logarithms.

Whereas, before the aforefaid Contrivance of the Indices by Mr. Townley, if one Number were perfect, and the other a Decimal, there was a different Rule in every Operation for them; but by the said Contrivance one is now sufficient: I will give Examples only, in which one Number is a Decimal, with these two Directions.

1. In the Log. which answereth the Question, (whether it be a Sum, Remainder, Half, &c.) if the Index be ten, or above, neglect or cancel the said Figure in the Place of Tens.

2. Where you are ordered to subtract a greater Log. out of a less; add ten to the Index of the less, and then subtract.

1. *Multiplication.*

Add the Logs. of the two, or more Numbers to be multiplied; the Sum is the Log. of the Product. So 12 multiplied by the Decimal 25, the Product is 3.

$$\begin{array}{r} 12. \quad 1.07918 \\ \text{By } .25 \quad 9.39794 \\ 3. \quad 1 \quad 0.47712 \end{array}$$

It may also be done where there are but two, by subtracting the Arithmetick Complement of the Log. of one of them out of the Log. of the other; the Remainder is the Log. of the Product.

Which Arithmetical Complement is the Remainder of every Figure, (including the Index) to 9; except of the last significant Figure to the right Hand, whose Remainder you must take to Ten. As in these three Examples.

Numb.

$$2. \quad 0.30103 \quad \text{Log.}$$

$$.5 \quad 9.69897 \quad \text{Ar. Compl.}$$

Numb.

$$80. \quad 1.90309 \quad \text{Log.}$$

$$.0125 \quad 8.09691 \quad \text{Ar. Compl.}$$

Numb.

$$100 \quad 2.00000 \quad \text{Log.}$$

$$.01 \quad 8.00000 \quad \text{Ar. Compl.}$$

2. *Division.*

Subtract the Log. of the Divisor out of the Log. of the Dividend, (whether of the two

be greater or less) the Remainder is the Log. of the Quotient. So 12 divided by the Decimal .25; the Quotient is 48.

$$\begin{array}{r} 12. \quad 1.07918 \\ \text{By } .25 \quad 9.39794 \\ \hline 48. \quad 1.68124 \end{array}$$

It may also very conveniently be done, by adding the Ar. Compl. of the Log. of the Divisor to the Log. of the Dividend; the Sum is the Log. of the Quotient, as followeth.

3. *The Rule of Three Direct.*

1. Add the Logarithms of the second and third; from the Sum subtract the Log. of the first; the Remainder is the Log. of the fourth.

2. A better Way: Add the Ar. Compl. of the Log. of the first to the Logarithms of the second and third; the Sum is the Log. of the fourth. *Example.* If .25 give 16. What shall 12. give?

$$\begin{array}{r} \text{Ar. Compl. } .25 \quad 0.60206 \\ 16. \quad 1.20412 \\ 12. \quad 1.07918 \\ \hline 768. \quad 2.88536 \end{array}$$

Ans. 768.

But in the inverse Rule: Add the Ar. Compl. of the Log. of the third to the Logarithms of the first and second; the Sum is the Log. of the fourth. Thus are resolv'd the Questions

wrought on the double Scale.

But for those in this Book, where there is a duplicate Proportion, as in Timber Measure and Gauging, if the first and third Numbers be on the square Line, there are general or fix'd Logarithms belonging to the first Numbers; to which if you add the Log. of the second, and the Log. of the third twice, the Sum of all four is the Log. of the fourth.

If the second and fourth Numbers be on the square Line; to the Ar. Compl. of the Log. of the first, add the Log. of the third, and the Log. of the second twice, half the Sum is the Log. of the fourth.

4. *The Square Root.*

Half the Log. of the Number given, is the full Log. of the Square Root.

If the Number be a Decimal, add ten to the Index, and then halve it, as here.

$$\begin{array}{r} .25 \quad 19.39794 \\ .5 \quad 9.69897 \end{array}$$

5. *The Cube Root.*

The third Part of the Log. of the Number given, is the full Log. of the Cube Root.

If the Number be a Decimal, add twenty to the Index, and then divide by three, as here.

$$\begin{array}{r} .25 \quad 29.39794 \\ .63 \quad 9.79931 \end{array}$$

6. *To find a mean Proportional between two Numbers.*

Add their Logs. together : Half the Sum is the Log. of the mean Proportional.

When one is a Decimal, if the Sum of the Indices be ten, (as here) or above ; cast away ten, and then halve it ; if it be not ten, add ten to it, and then halve it.

$$\begin{array}{r}
 12. \quad 1.07918 \\
 .25 \quad 9.39794 \\
 \hline
 10.47712 \\
 1.732 \quad 0.23856
 \end{array}$$

7. *To find two, or more mean Proportionals between two Numbers.*

This, in Case of a Decimal, was something perplex'd, as you may see in Mr. *Wingate's* Artificial Arithmetick : It is now, by the aforefaid Contrivance of Mr. *Townley*, as easy, as it is useful.

Subtract the Log. of the less Number out of the Log. of the greater : The Remainder divide by a Number greater by one, than the Number of Means sought ; as here, by 4 for three Means.

$$\begin{array}{r}
 12. \quad 1.07918 \\
 .25 \quad 9.39794 \\
 \hline
 1.68124 \\
 42031
 \end{array}$$

This Quotient added to the

Log. of the less Number ; the Sum is the Log. of the first Mean ; to which adding again the said Quotient, the Sum is the Log. of the second Mean. And so forward for as many Means, as the Quotient was at first ordered for.

Means.

$$\begin{array}{r}
 9.39794 \\
 42031 \\
 \hline
 1 \quad .658 \quad 9.81825 \\
 42031 \\
 \hline
 2 \quad 1.732 \quad 0.23856 \\
 42031 \\
 \hline
 3 \quad 4.556 \quad 0.65887
 \end{array}$$

8. *To find the Log. of a Vulgar Fraction.*

Subtract the Log. of the Denominator out of the Log. of the Numerator, the Remainder is the Log. of a Decimal equivalent to the said vulgar Fraction.

$$\begin{array}{r}
 \frac{3}{4} \quad 0.47712 \\
 \phantom{\frac{3}{4}} 0.60206 \\
 \hline
 .75 \quad 9.87506
 \end{array}$$

9. *To find the Log. of a Number with a Vulgar Fraction annex'd.*

Suppose it to be $12 \frac{1}{4}$; change the Number into an improper Fraction, by multiplying the whole Number by the Denominator of the Fraction, and adding the Numerator to the Product,

duct, the Sum is the Numerator of the improper Fraction.

$$\begin{array}{r}
 4\frac{2}{4} \quad 1.69020 \\
 \quad \quad 0.60206 \\
 \hline
 12.25 \quad 108814
 \end{array}$$

Then subtract the Log. of the Denominator out of the Log. of the Numerator, as before ; the Remainder is the Log. of the said Number, with a De-

cimal, equal to the said vulgar Fraction, annexed.

I have, as an Appendix to this Part, adjoined the usual Decimal Tables, and comprised them into five : Yet the Use of them is as easy, as if they were all single.

The Integers, or Wholes, are set on the Top ; and the Parts follow in order, with their Decimals annexed.

TABLE

T A B L E I.

*A Table of English Coin, a Pound Sterling, } Integer.
also Troy Weight, an Ounce*

Shillings and Penny Weight.	Decimals.	Pence with Farthings.	Decimals.	Grains.	The Residue of the Table.		
					Pence with Farthings.	Decimals.	Grains.
19	.95	3	.0489583				
18	.9	2	.0479166	23			
17	.85	1	.046875				
16	.8	11	.0458333	22			
15	.75	3	.0447916				
14	.7	2	.04375	21	5	.0201333	10
13	.65	1	.0427083		3	.0197916	
12	.6	10	.0416666	20	2	.01875	9
11	.55	3	.040625		1	.0177083	
10	.5	2	.0395833	19	4	.0166666	8
9	.45	1	.0385416		3	.015625	
8	.4	9	.0375	18	2	.0145833	7
7	.35	3	.0364583		1	.0135416	
6	.3	2	.0354166	17	3	.0125	6
5	.25	1	.034375		3	.0114583	
4	.2	8	.0333333	16	2	.0104166	5
3	.15	3	.0322916		1	.009375	
2	.1	2	.03125	15	2	.0083333	4
1	.05	1	.0302083		3	.0072916	
		7	.0291666	14	2	.00625	3
		3	.028125		1	.0052083	
		2	.0270833	13	1	.0041666	2
		1	.0260416		3	.003125	
		6	.025	12	2	.0020833	1
		3	.0239583		1	.0010416	$\frac{1}{2}$
		2	.0229166	11	$\frac{1}{2}$.0005208	$\frac{1}{2}$
		1	.021875				

T A B L E II.

Averdupois great Weight, One hundred at 112 l.
Integer.

Quar- ters.	Decimals.	<i>The Residue of the Table.</i>	
3	.75		
2	.5	Ounces. Decimals.	
1	.25		
Pounds.	Decimals.		
27	.2410714	15	.0083705
26	.2321428	14	.0078126
25	.2232143	13	.0072545
24	.2142857	12	.0066964
23	.2053571	11	.0061384
22	.1964286	10	.0055803
21	.1875	9	.0050223
20	.1785714	8	.0044643
19	.1696428	7	.0039062
18	.1607143	6	.0033482
17	.1517857	5	.0027902
16	.1428571	4	.0022321
15	.1339286	3	.0016741
14	.125	2	.0011161
13	.1160714	1	.000558
12	.1071428	Quar- ters. Decimals.	
11	.0982143		
10	.0892857	3	.0004185
9	.0803571	2	.000279
8	.0714286	1	.0001395
7	.0625		
6	.0535714		
5	.0446428		
4	.0357143		
3	.0267857		
2	.0178571		
1	.0089286		

T A B L E III.

*Averdupois little Weight, one Pound long } Integer.
Measure, one Yard or Ell,*

Ounces.	Decimals.	Qtrs. with Nails.	<i>The Residue of the Table.</i>		
			Drams.	Decimals.	Qtrs. of Nails.
15	.9375	3	15	.0585937	3
14	.875	2	14	.0546875	
13	.8125	1	13	.0507812	
12	.75	3	12	.046875	
11	.6875	3	11	.0429687	
10	.625	2	10	.0390625	2
9	.5625	1	9	.0351562	
8	.5	2	8	.03125	
7	.4375	3	7	.0273437	
6	.375	2	6	.0234375	
5	.3125	1	5	.0195312	1
4	.25	1	4	.015625	
3	.1875	3	3	.0117187	
2	.125	2	2	.0078125	
1	.0625	1	1	.0039062	
			Qtrs.	Decimals.	
			3	.0029297	
			2	.0019531	
			1	.0009765	

TABLE IV.

Liquid Measure,
one Gallon.
Dry Measure, one
Quarter. } *Integer.*

Pints.	Decimals.	Bushels
7	.875	7
6	.75	6
5	.625	5
4	.5	4
3	.375	3
2	.25	2
1	.125	1
Quar- ters.	Decimals.	Pecks.
3	.09375	3
2	.0625	2
1	.03125	1
	Decimals	Quar- ters of a Peck.
	.0234375	3
	.015625	2
	.0078125	1
	Decimals	Pin
	.0058594	3
	.0039063	2
	.0019531	1

TABLE V.

Dozens, or Gross
Time, one Year.
Long Meas. 1 Foot.
Pence 1 Shilling. } *Integer.*

Dozens. Months	Decimals.	Inches Pence.
11	.9166667	11
10	.8333333	10
9	.75	9
8	.6666667	8
7	.5833333	7
6	.5	6
5	.4166667	5
4	.3333333	4
3	.25	3
2	.1666667	2
1	.0833333	1
Parts.	Decimals.	Quar- ters & Farth.
11	.0763889	
10	.0694444	
9	.0625	3
8	.0555555	
7	.0486111	
6	.0416667	2
5	.0347222	
4	.0277778	
3	.0208333	1
2	.0138889	
1	.0069444	

Days belonging to the Table of Time.

Days.	Decimals.		Days	Decimals.
30	.08219178		15	.0410959
29	.079452		14	.0383562
28	.0767123		13	.0356164
27	.0739726		12	.0328767
26	.0712329		11	.030137
25	.0684931		10	.0273972
24	.0657534		9	.0246575
23	.0630137		8	.0219178
22	.060274		7	.0191781
21	.0575342		6	.0164383
20	.0547945		5	.0136986
19	.0520548		4	.0109589
18	.0493151		3	.0082192
17	.0465753		2	.0054794
16	.0438356		1	.0027397

To bring Decimals into known Parts.

Multiply the Number of Parts in one Integer, and the Decimals together: From the Product cut off so many Figures to the right Hand as are in the Decimals (as you are directed in Multiplication of Decimals.) The Residue to the left Hand are the Parts sought; and the Figures cut off are a Decimal of one of those Parts, to be reduced the same way into the next less Parts, if there be any, or if there be need. If nothing be left to the left Hand, there

is not one of those Parts in that Decimal: Therefore account it cut off, and proceed to find the next less Parts, as before.

The making the foregoing Tables is by dividing the Numerator of the vulgar Fraction, which represents the Parts, by the Denominator; the Quotient is the Decimal. So $\frac{11}{20}$ being the vulgar Fraction of 11 Shillings, or 11 Penny-weights; if you divide 11 by 20, the Quotient .55 is the Decimal: So that half the Number of Shillings or Penny-weights is the Decimal. Also $\frac{26}{960}$ being the vulgar Fraction of 6 d. $\frac{4}{3}$ or of 26 Farthings; if you divide 26 by

by 960, the Quotient .0270830, *£c.* is the Decimal.

Yet you shall not need Division for every Decimal; for some are found by halving the Integer or 1: and so continually: So are found the Decimal of one half, one quarter, one half quarter, *£c.* Some are found by halving a Decimal before found: So half the Decimal of a Shilling, is the Decimal of Six-pence; half of that the Decimal of Three-pence, *£c.* Also one third Part of the Decimal of a Shilling, is the Decimal of Four-pence; and the half of that, the Decimal of Two-pence, *£c.* and the double of it the Decimal of Eight-pence. Likewise the Sum of two Decimals, is the Decimal of the Sum of the two Fractions whose Decimals they are; and

Having added the Decimals of the Parts, the Question will stand thus:

$$\begin{array}{rcl} \text{ou.} & \text{l.} & \text{ou.} & \text{p.} & \text{l.} \\ 1 & : 0.2645833 & :: & 7.1895833 & : 1.9022 \end{array}$$

The Product or Answer is 1 *l.* 9022, *£c.* Which is 1. *l.* 18 *s.* 0 *d.* 2 *f.* near.

If you leave out the three last Figures in each Decimal, with the Condition abovementioned, the Numbers are

$$\begin{array}{rcl} \text{ou.} & \text{l.} & \text{ou.} \\ 1 & : 0.2646 & :: 7.1896 \end{array}$$

And the Answer is 1 *l.* 9023. *£c.* differing from the other inconsiderably.

2. To compute simple Interest for any Sum, Rate and Time. Having put the Parts, if there be any, into their Decimals; multiply the Principal and the Rate; from the Pro-

the Difference is the Decimal of their Difference.

Some of these are of one Place, and some of more: Few Tables have them to above seven; and most ordinary Questions may be resolved to a sufficient Exactness, if you use but four; remembering the Direction above given, *viz.* If the first Figure of those left out exceed 5, to add a Unite to the last of those you retain.

If the Answer of a Question be in Money, three Places of Decimals give it to near a Farthing, as is shewn after *Part 4. Prop. 5.*

Now for the Use of them in a Question or two.

1. At 5 *s.* 3 *d.* $\frac{1}{2}$ the Ounce; what cost 7 Ounces, 3 Pennyweight, and 19 Grains?

duct cut off the due Decimal, if any, and two Places more for the Division by 100: This Product so ordered is the Interest due for one Year; which if you multiply by the Time, (be

(be it more or less than a Year) the Product (the due Decimal cut off) is the Interest for that Time.

Example 1. What is the simple Interest of 132 *l.* 7 *s.* 6 *d.* for 2 *y.* 3 *m.* 22 *d.* at 6 *l.* in the Hundred?

The Decimal of 7 *s.* 6 *d.* is .375; which being annexed to the whole Pounds, the Principal will be 132 *l.* 375, which multiplied by 6, and the Product ordered as directed, it will be 7.9425, or 7 *l.* 18 *s.* 10 *d.* 1 *f.* near, for the Interest for one Year. But that being not the Sum sought, multiply the said 7.9425 and the Time, *viz.* 2 *y.* 3103, the Product 18.3493 is the Interest sought, *viz.* 18 *l.* 6 *s.* 11 *d.* 3 *f.*

Example 2. What is the Interest of the said Sum for two Months and ten Days at the same Rate? Multiply the said 7.9425 by .1941 the Decimal of the Time, the Product 1 *l.* 5416, or 1 *l.* 10 *s.* 10 *d.* is the Interest sought.

But the great Convenience of Decimals, is, that their Logs. are so easily found; as is already shewn in this second Section. So that by the *Tabulæ Logarithmicæ* mentioned in the aforecited Place, any Question, whose Numbers (whether whole, mixt, or Decimals) exceed not six Places, may be speedily resolved: Mr. *Townley's* Indices of the Decimals freeing us from Perplexity of different Rules. As in the two last Examples.

Example 1.

100. *Ar. Com.* 8.

132.375.	2.1218052
6.	0.7781512
7.9425	0.8999571
2.3103	0.3636083
18.3495	1.2636254

Example 2.

100. *Ar. Com.* 8.

132.375	2.1218059
6.	0.7781512
.1941	9.2880255
1.5410	0.1879826

To the Arith. Compl. of the Log. of 100, *viz.* 8.0000000 add the Log. of the Principal and of the Rate; the Sum is the Log. of the Interest for one Year. To which Log. if you add the Log. of the Time, this Sum shall be the Log. of the Interest for the Time.

Or without seeking the Interest for one Year: To the said *Ar. Compl.* add the Logs. of the Principal, Rate, and Time, the Sum shall be the Log. of the Interest demanded, as in the second Example.

3. Compound Interest for any Principal, Rate, and Time by the Logarithms.

In this Proposition the Excellency of those Numbers appear; such Questions being resolved by them with great Ease and Speed; but by natural Arithmetick not without considerable Time and Trouble.

Deduct the Log. of 100 from the Log. of 100, and the Rate added

added together, as 105, 106, &c. The Difference multiply by the Time: From the Product cut off the Decimal, if there be any: The Remainder add to the Logarithm of the Principal; the Sum is the Logarithm of the Principal and Interest required.

Example.

Let the Principal, Rate, and Time be as in the former of the two last Questions. Pursuing the Rule, as you see in the Margin; the Sum of the principal and compound Interest is 151 *l.* 9 *s.*

<i>The Difference</i>	253058
<i>The Time</i>	2.3103
<i>The Product</i>	<u>584029.8974</u>
132.375	2.1218059
	<u>584639</u>
151.45	2.1102698

It seems by this, that the Interest of 100 *l.* at 6 *l.* per Cent. by the Year, is not fully amounted to 3 *l.* in six Months; for if you multiply the aforefaid Difference by 5, the Decimal of six Months; and, having cut off one Place, add the Residue to the Log. of 100, the Sum will be 2.0126529; which is the Log. of 102.956, that is 102 *l.* 19 *s.* 1 *d.* 1 *f.*

I will add two or three Examples more, which, I hope, will be sufficient.

1. What is the Value of 28 Ounces, six Penny Weights and 15 Grains of Gold, at 3 *l.* 3 *s.* 6 *d.* the Ounce? Annexing the Decimals to the Integers, the Numbers stand thus:

$$\begin{array}{ccc} \text{ou.} & \text{l.} & \text{ou.} & \text{l.} \\ 1 & : 3.175 & : : 28.33125 & : 89.952 \end{array}$$

<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>f.</i>	3.175	9.5017437
<i>Facit,</i>	89 . 19	:	00 . 2	28.33125	<u>1.4522657</u>
				89.952	1.9540094

2. If 4 . 9 . 12 of Gold cost 14 . 10 . 9; What is that the Ounce?

$$\begin{array}{ccc} \text{ou.} & \text{l.} & \text{ou.} & \text{l.} \\ \text{The Numbers are} & 4.475 & : 14.51875 & : : 1 : 3.2444 \end{array}$$

<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>f.</i>	4.475	<i>Ar. Compl.</i>	9.3492070
<i>Facit</i> , 3	. 04	. 10	. 2.	1451875		1.1619291

3.2444

.5111361

3. At 6s. 3d. the Ounce ; how much Silver Plate will 5l. 3s. 6d. buy?

<i>l.</i>	<i>ou.</i>	<i>l.</i>	<i>ou.</i>
The Numbers are 0.3125	: 1	: 5.175	: 16.56

<i>ou.</i>	<i>p.</i>	<i>gr.</i>	.3125	<i>Ar. Compl.</i>	0.50515
<i>Facit</i> , 16.	11.	05 near.	5.175		0.71391

16.56

1.21909

I have taken but six Figures in this last Example. If I had used no more in the other, the Difference would have been little or inconsiderable ; as you may find if you please to give your self that small Trouble.

TRILATERAL [in *Geometry*] three sided.

TRILLION [in *Arithmetic*] the Number of a Billion of Billions.

To TRIM [in *Carpentry*, &c.] a Term us'd for fitting one Piece into another, who then say, trim in a Piece.

TRIMMERS [in *Architecture*] Pieces of Timber that are fram'd at Right Angles to the Joints, against the ways for Chimneys and Well Holes for Stairs.

TRINE *Dimension*, or three-fold *Dimensions*, includes Length Breadth and Thickness. The *Trine Dimension* is peculiar to Bodies or Solids.

TRINGLE [in *Architecture*] a Name common to several little square Members or Ornaments, as *Reglets*, *Lifels*, or *Plat-bands*.

TRINGLE is particularly us'd for a little Member fix'd exactly over every Triglyph, under the Plat-Band of the Architrave, from whence the *Gutta* or Pendant Drops, hang down.

TRIPARTITION is a Division by three ; or the taking the third Part of any Number or Quantity.

TRIPLE, *Three-fold*.

TRISECTION } [in *Geometry*]
TRISSECTION }
the dividing a Thing by three ; it is chiefly us'd for the Division of an Angle.

The Trisection of an Angle Geometrically, is one of those great Problems, the Solution of which has been so much sought after by Mathematicians for 2000 Years ; being in this respect on a Footing with the Quadrature of the Circle, and the duplicate of the Cube Angle.

Several late Authors have written on the *Trisection of a Triangle* ; and pretend to have found out the Demonstration, but they have all committed Paralogisms.

TROCHILE ? [in *Architecture*]
TROCHILUS } is that hollow Ring or Cavity, which runs round a Column, next to the *Tore*; or it is one whose Cavity is compos'd of two Arches.

TROCHLEA is one of the Mechanical Powers, and is what we usually call the Pulley.

TROCHOID [in *Geometry*] a Curve, whose Genesis may be thus conceiv'd. If a Wheel or Circle be mov'd with a two-fold Motion at the same time, the one in a Right-Line, and the other circularly about its Centre, and these two Motions be equal; *i. e.* describe two equal Lines in the same time: and if in the Radius; which at the beginning of the Motion reaches from the Centre of the Wheel, or the first Point of the Line, which describes the Circumference. If, I say, in this Radius a Point be taken any where, except in the Centre, this Point will describe a Curve, one Part of which will be below the Line describ'd by the Centre, and the other above it; this Line thus describ'd by the Point taken in the Radius, is call'd the *Trochoid*.

The Right-Line which joins the two Extremities of the *Trochoid*, and which is either the Path the Wheel makes, or a Line parallel to that Path is call'd the Base of the *Trochoid*.

The Axis of the *Trochoid* is the Diameter of the Wheel, perpendicular to the Base in the middle of the Motion; or that Part of the Radius between the *Trochoid* and its Base.

The Point wherein the Axis is cut into two Parts by the Line describ'd by the Centre of the Wheel, is call'd the Centre of the *Trochoid*; the uppermost Point of the Axis, the Vertex of the *Trochoid*; and the Plane comprehended between the *Trochoid* and its Base, the *Trochoidal Space*.

The *Trochoid* is the same with what is otherwise call'd the *Cycloid*; the Properties, &c. of which you may see under the Article *Cycloid*.

TROPHY [in *Architecture*] is an Ornament which represents the Trunk of a Tree, charg'd or encompass'd all around about with Arms or military Weapons, both offensive and defensive.

TRUNCATED *Pyramid*, or *Cone*, is one whose Top or Vertex is cut off by a Plane parallel to its Base.

TRUNK [in *Architecture*] is us'd for the Fust or Shaft of a Column, with that Part of the Pedestal between the Base and the Cornice, call'd the Die.

TUBE, a *Pipe*, *Conduit* or *Canal*; being a Cylinder hollow within, either of Iron, Lead, Wood, &c. for the Air or some other Fluid to have a free Passage.

TUSCAN *Order* [in *Architecture*] is the first, simplest and most massive of the five Orders.

The *Tuscan* is call'd the *Rustic* Order by *Vitruvius*, and *M. de Chambray* agrees with him, who in his *Parallel* says, it never ought to be us'd but in Country Houses and Palaces.

M. Le

M. *Le Clerc* adds, that in the Manner *Vitruvius* and *Paladio*, and some others have ordered it, it does not deserve to be us'd at all. But in *Vignola's* Manner of Composition, he allows it a Beauty, even in its Simplicity; and such as makes it proper, not only for private Houses, but even for publick Buildings; as in the Piazza's of Squares and Markets; in the Magazines and Granaries of Cities, and even in the Offices and lower Apartments of Palaces.

The *Tuscan* has its Character and Proportions, as well as the other Orders; but we have no ancient Monument, to give us any regular *Tuscan* Order for a Standard.

M *Perrault* observes, that the Characters of the *Tuscan* are nearly the same with those of the *Doric*; and adds, that the *Tuscan* is in Effect no other than the *Doric*, made somewhat stronger, by shortening the Shaft of the Column; and more simple, by the small Number and largeness of the Mouldings.

Vitruvius makes the whole Height of the Order 14 Modules, in which he is follow'd by *Vitruvius*, M. *Le Clerc*, &c. *Serlio* makes it but 12; *Paladio* gives us one *Tuscan* Profile much the same as that of *Vitruvius*, and another too rich, on which Side *Scamozzi* is likewise too faulty.

Hence it is that that of *Vignola*, who has made the Order very regular, is most follow'd by modern Architects.

The *Tuscan* is the most easily executed of all the Orders; in that it has neither Triglyphs, nor Dentils, nor Modillions to confine its Inter-columns.

On this Account, the Columns of this Order may be rang'd in any of the five Manners of *Vitruvius*, viz. the *Pycnostyle*, *Sistyle*, *Eustyle*, *Diastyle* and *Areostyle*.

TUSCAN Order, by Proportions of equal Parts.

The Height of the *Pedestal* being two Diameters, is divided into 4, giving 1 to the Base, whose Plinth^a is $\frac{2}{3}$ thereof, the other Part is divided into 3, giving 1 to the Fillet^b, and 2 to the Hollow^c. The Breadth of the Die, or Naked, is one Diameter and $\frac{1}{2}$: and the *Projection* of the Base is equal to its Height the Fillet hath $\frac{3}{4}$ thereof.

The Height of the *Cornice* is half the Base, being $\frac{1}{2}$ of the whole Height, and is divided into 8, giving 2 to the Hollow^d, 1 to the Fillet^e, and 5 to the Band^f; the *Projection* is equal to the Base, and the Fillet hath three of these Parts.

Base of the Column: The Height is $\frac{1}{2}$ a Diameter, and is divided into six Parts, giving 3 to the Plinth^g, 2 and $\frac{1}{2}$ to the Torus^h, and $\frac{1}{2}$ a Part to the Fillet; the whole *Projection* is $\frac{1}{3}$ of its Height, and the Fillet equal to its Height. The Hollow or Cinctureⁱ is $\frac{1}{4}$ of a Circle in all the Orders, and belongs to the Shaft of the Column.

The *Diminishing* of this Column is $\frac{1}{4}$ of the Diameter.

The Height of the *Capital* is $\frac{1}{2}$ a Diameter, and is divided into 9, giving $2\frac{1}{2}$ to the Frieze^k of the Capital, $\frac{1}{2}$ a Part to the Fillet, 3 to the Ovolo^l, and 3 to the Abacus^m. The whole *Projection* is $\frac{1}{8}$ of the Diameter being perpendicular to the Body of the Column below, and the Fillet projects equal to its Height.

The *Collerino*ⁿ or Necking of all the Orders in general is one of those nine Parts in the Capital, and the Fillet half a Part; the *Projection* is 1 and $\frac{1}{4}$ of these Parts, and the Fillet equal to its Height.

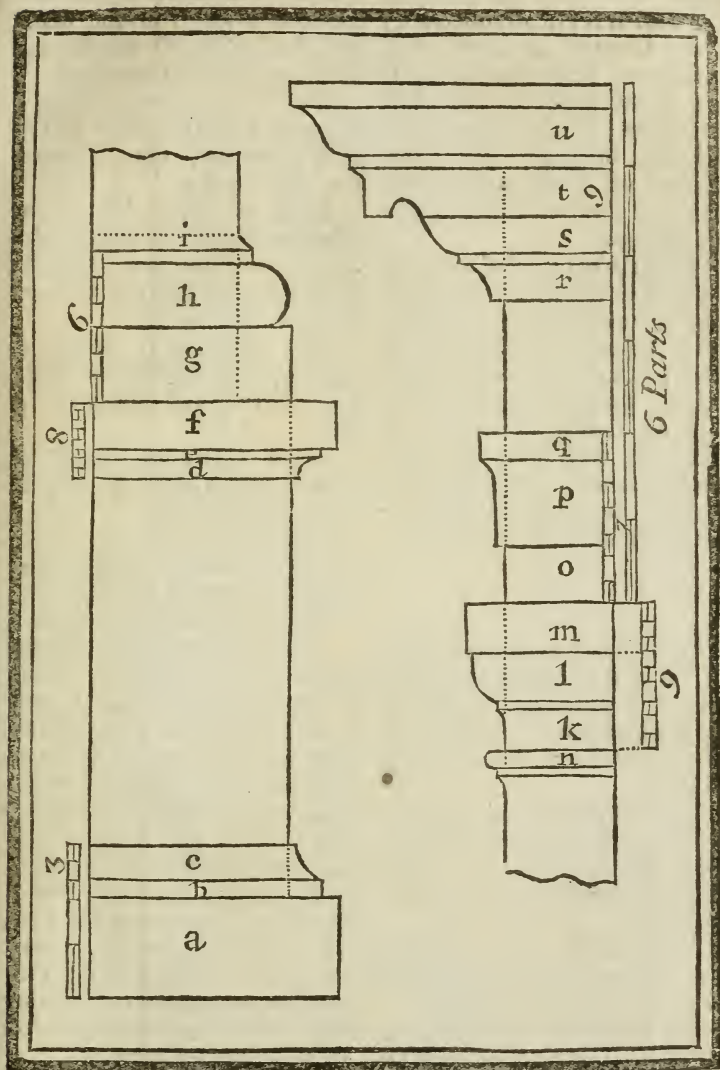
The Height of the *Entablature* being one Diameter and $\frac{3}{4}$, is divided into 6, giving 2 to the Architrave, 1 and $\frac{1}{2}$ to the Frize, and $2\frac{1}{2}$ to the Cornice.

For the Members of the *Architrave*, divide the Height into seven Parts, giving 2 and $\frac{1}{2}$ to the first Face^o, 3 and $\frac{1}{2}$ to the second^p, and 1 to the Band at Top^a; the *Projection* is equal to the Band, and the second Face a third thereof.

N. B. The first Face of all the *Architraves* is perpendicular to the Naked of the Column at the Top.

For the *Cornice*, divide the Height into 9, giving 1 $\frac{1}{2}$ to the Hollow^r, $\frac{1}{2}$ a Part to the Fillet, 1 and $\frac{1}{2}$ to the Ovolo^f, 2 to the Corona^t, $\frac{1}{2}$ a Part to the Fillet, 2 to the Scima Recta^v, and 1 to the Fillet. For the *Projections*, the Hollow hath 2 of these Parts, the Ovolo 3 and $\frac{1}{2}$, the Corona 6, the Fillet 6 and $\frac{1}{2}$, and the Whole 9, being equal to the Height.

The Proportion of the TUSCAN Order, by equal Parts.



TUSK [in *Carpentry*] a Bevel Shoulder, made to strengthen the Tenon of the Joist, which is let into the Girder.

TYMPAN [in *Architecture*] is the Ground or Area of a Pediment; being that which is in a Level with the Naked of the Frieze: Or it is the Space included between the three Cornices of a triangular Pediment, or the two Cornices of a circular one.

TYMPAN [in *Architecture*] is also the Tympan of an Arch in a triangular Space or Table in the Corners or Sides of the Arch; usually hollow'd or enrich'd, sometimes with Branches of *Laurel*, *Olive-Tree* or *Oak*; or with *Trophies*, &c. sometimes with *Flying Figures*, as *Fame*, &c. or *Sitting Figures*, as the *Cardinal Vertues*, &c.

V

VAGINA [in *Architecture*] is us'd to signify the lower Part of a *Terminus*, because of its Resemblance to a Sheath, out of which the Statue seems to issue.

The *Vagina* is that long Part between the Base and the Capital; and is found in divers Manners and with divers Ornaments.

VALLEYS [in *Building*] the Gutters over the Sleepers in the Roof of a Building.

VARNISH is a thick, vis-

VERNISH is a thick, shining Liquor, us'd by Painters, Gilders, and various other Artificers, to give a Gloss and Lustre to their Works; as also to de-

fend them from the Weather, Dust, &c.

There are several kinds of Varnishes in Use; as the *Siccative* or drying *Varnish*, made of Oil of *Aspin*, *Turpentine* and *Sandarack* melted together.

White VARNISH, call'd also *Venetian Varnish*, made of Oil of Turpentine, Fine Turpentine and Mastic.

Spirit of Wine VARNISH, made of *Sandarack*, *White Amber*, *Gum Elemi* and *Mastick*; serving to gild Leather, Picture-Frames, &c. withal.

Gilt VARNISH, made of *Linseed Oil*, *Sandarack*, *Aloes*, *Gum Gutta*, and *Litharge of Gold*.

China VARNISH, made of *Gum Lacca*, *Colephony*, *Mastic*, and *Spirit of Wine*.

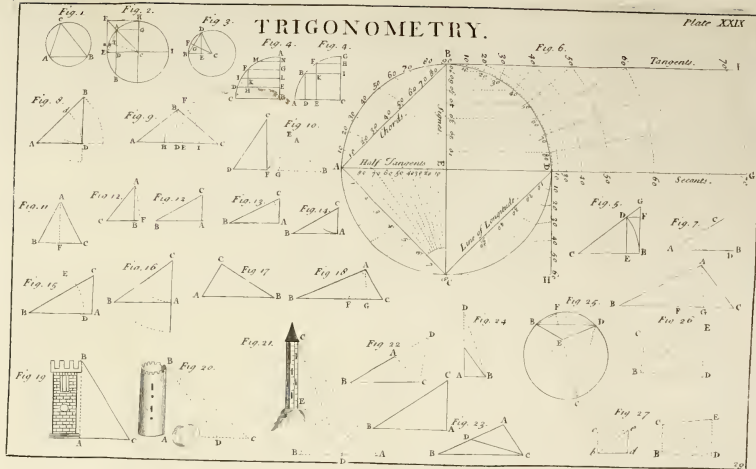
Common VARNISH, which is only common *Turpentine*, dissolv'd in *Oil of Turpentine*.

White VARNISH } From a
Amber VARNISH } Manuscript of Mr. Boyle. Take white Resin four Drams, melt it over the Fire in a cleanglaz'd Pipkin, then put into it two Ounces of the whitest Amber you can get (finely powdered) this is to be put in by a little and a little, gradually, keeping it stirring all the while with a small Stick, over a gentle Fire, till it dissolves, pouring in now and then a little Oil of Turpentine, as you find it growing stiff; and continue so to do till all your Amber is melted.

But great Care must be taken not to set the House on Fire, for the very Vapours of the Oil of Turpentine will take Fire

TRIGONOMETRY.

Plate XXIX



Fire by Heat only; but if it shall happen so to do, immediately put a flat Board or wet Blanket over the fiery Pot, and by keeping the Air from it, you will put it out, or suffocate it.

Therefore it will be best to melt the Rosin in a Glass of a Cylindric Figure in a Bed of hot Sand, after the Glass has been well *anneal'd* or warm'd by Degrees in the Sand, under which you must keep a gentle Fire.

When the Varnish has been thus made, pour it into a coarse Linnen Bag, and press it between two hot Boards of Oak or flat Plates of Iron; after which it may be us'd with any Colours in Painting, and also for varnishing them over when painted.

But for covering Gold, you must use the following Varnish: this is to be observ'd, that when you have varnish'd with white Varnish, you may put the Things varnish'd into a declining Oven, which will harden the Varnish.

A Hard VARNISH, which will bear the Muffle (from a Manuscript of Mr. Boyle's) for laying over any Metal, that appears like Gold, to prevent it from turning black, which all but Gold will be apt to do, when expos'd to the Air.

Take of *Colophony*, which is to be had at the Druggists, an Ounce; set it over the Fire in a well glaz'd earthen Vessel, till it is melted; then by little and little, strew in two Ounces of Powder of *Amber*, keeping stirring it all the while

with a Stick; and when you perceive it begin to harden or resist the Stick, then put in a little Turpentine Oil, which will thin and soften it immediately; then put in two Ounces of *Gum Copal* [finely powdered] sprinkling it in as you did the *Amber*, ever and anon pouring in a little Oil of Turpentine, and when it is done, strain it as before directed.

This is proper to varnish over Gold, and the Things done with it, must be set into a declining Oven, three or four Days successively, and then it will resist even the Fire.

A VARNISH for Brasses to make it look like Gold.

This is us'd upon Leaf Gold, or upon that which is call'd *Dutch* or *German* Leaf-Gold, or upon Brasses or Bath-Metal, which are design'd to imitate Gold.

Take two Quarts of *Spirit of Wine*, and put it into a Retort Glass; then add to it an Ounce of *Gamboge*, two Ounces of *Lake*, and two Ounces of *Gum Mastick*; set this in a Sand Heat for six Days, or else near a Fire, or you may put the Body of the Retort frequently into warm Water, and shake it two or three times a Day; then set it over a Pan of warm Small Coal Dust, before you lay this Varnish over the Metal, to be sure you see that it has been well clean'd, varnish it over thinly with this Varnish, and it will appear of the Colour of Gold. Set it in

a declining Oven to harden, and it will not rub off.

N. B. This is a good Varnish to mix with any Colours that incline to red, and the white Varnish for mixing with those that are pale.

A VARNISH for Wood, Paper, &c.

The *Japanese* have a Method of making Plates, Bowls and other Vessels of brown Paper, and sometimes of fine Saw-Dust; which Vessels are very light, and very strong, which by Reason they are not liable to be broken by a Fall as *China* Ware or Porcelaine made of Earth, are much esteem'd with us. The Method of making them is as follows.

Take brown Paper, boil it in common Water, stirring and mashing it all the while with a Stick, till it is almost become a Paste; then take it out and pound it well in a Stone Mortar, till it is reduc'd to a soft pappy Consistence, like Rags for Paper making; then with common Water and Gum Arabic, a Quantity sufficient to cover this Paper Paste an Inch, put these together in a well glaz'd Pipkin, and boil them well, keeping continually stirring them, till the Paste is well impregnated with the Gum; then is your Paste fit for making any Form you design.

Having the Mould ready made, as suppose any Thing of the Figure of a Plate, you must have hard Wood turn'd on one Side of such a Figure,

with a Holè or two in the middle, quite through the Wood, to let any Water pass through that is press'd out of the Paste; which Mould must be concave and in the middle in the Form, of the under-side of a Plate, also another Piece of hard Wood must also be turned convex in the middle, and in the Form of the upper-side of a Plate; this must be about the eighth Part of an Inch less than the under Mould; but about the Rim or the Edge, you may, if you please, have some little Ornament carv'd or engraven in the Wood.

These Moulds must be well oil'd on the turn'd Sides, as soon as they are made, and must be continued oiling, till they have been thoroughly drench'd with Oil, and oil them well again just before you use them, to prevent the gummed Paste from sticking to the Wood; set the under Mould upon a strong Table even, and spread it over with some of your Paste as evenly as you possibly can, so as to be every where of an even Thickness of about a quarter of an Inch; then having oil'd the upper Mould, and put it as exactly as may be on the Paste, and press it hard down setting a great Weight upon it; letting it remain in that State for 24 Hours.

When you suppose the Paste to be dry, take it out of the Moulds, and when it is thoroughly dry, it will be as hard as Wood, and be fit to lay a Ground upon, made with strong Size and Lamp-black, letting it

it dry gently; and when that is thoroughly dry, mix Ivory-black with the following Varnish, and use it as hereafter directed.

A strong Japan VARNISH.

Take an Ounce of Colophony, and melt it in a well glaz'd earthen Vessel; then having three Ounces of Amber finely pulveriz'd and sifted, put it in by little and little, adding now and then some Spirit of Turpentine; when it is thoroughly melted, sprinkle in three Ounces of Sarcacolla, keeping it all the while stirring, putting in frequently more Spirit of Turpentine, till all is melted and well incorporated; then strain it through a coarse Hair Bag, plac'd between two hot Boards, and press it gently, receiving the Clear into a well glaz'd Pot, made warm; with this Varnish mix the ground Ivory-Black, and having first warm'd the Vessel made in the Mould, whatsoever Form it is, Plate, Bowl, &c. lay it on before the Fire in a warm Room, that the Air may not chill the Varnish; lay it on equally and then set it into a gentle Oven; and the next Day into a hotter, and the third Day into one that is very hot, letting it stand in it till the Oven is quite cold, and then it will be fit for any Use, either for Liquors cold or hot, and will never change, nor can they be broken but with great Difficulty.

As for the Moulds, it is probable they might do as well

if they were cast of any hard Metal, as if turn'd of Wood.

You may also make what Things you please of fine Saw-dust, by drying it well, and pouring on it some Turpentine; having an equal Quantity of Rosin melted with it, and half the Quantity of Bees-wax, mix them well together, and put them to the dry Saw-dust, stirring all together till the Mixture becomes thick as a Paste; then take it off the Fire, and having warm'd your Moulds, spread some of the Mixture on the under Mould, that has a Hole in the Middle, as equally as possible, and press the upper Mould upon it, as before; let it stand to cool, and your Vessel will be fit for painting.

There may, if you please, be some *Sarcacolla* finely powdered; put into this while your Turpentine is melting, to the Quantity of half the Turpentine; stirring it well, and it will harden it: This Varnish will most safely be made in the open Air, because it will endanger the House, and have a wet Cloth ready to put it out, if it takes Fire.

But which ever of the Mixtures you use, if you have a mind to have them appear like Gold, do them over with Gold Size, and when that begins to stick a little, with the Finger, lay on Leaf Gold, either real Gold, or that which is brought from *Germany*; but the last is apt to change green, as most of the Preparation from Brass will do; such as those which are call'd Bath-metal, and others

thers of the like Sort, which appear like Gold, when they are fresh polish'd, or clean'd every Day ; but as the Air coming upon them will make them alter to another Colour, Gold itself is rather to be choſen, which is durable, and will never change, and is alſo a much finer Colour than any of the former for a Continuance.

And altho' the Leaf Gold is tender, and may be ſuppoſed to be liable to rub off, yet the Varniſh with which it is to be varniſh'd over, will keep it bright and intire.

When the Leaf Gold has been laid on, and the flying Pieces brush'd off, which is not to be done till the Gold Size is dry, then varniſh it over with the following Varniſh.

VARNISH for Gold, or ſuch Leaf of Metals that imitate Gold.

Take Colophony, and having melted it, put in two Ounces of Amber, finely powdered, and ſome Spirit of Turpentine, and as the Amber thickens, keep it well ſtirring ; then put in an Ounce of Gum Elemi, well pulveriſed, and more Spirit of Turpentine, conſtantly ſtirring the Liquor till all is well mix'd and incorporated : But take care however to uſe as little Turpentine as you can ; becauſe the thicker the Varniſh is made, the harder it will be. Let this be done over a Sand-Heat, in an open Glaſs, then ſtrain it, as is directed for the preceeding Varniſh. This Varniſh is to be uſed alone ; firſt

warming the Veſſels made of Paper Paſte, and lay it on with a painting Bruſh before the Fire, but not too near, leaſt the Fire raiſe it into Bliſters : After this has been done, harden it three ſeveral Times in Ovens ; firſt with a ſlack Heat, the next with a warmer, and the third with a very hot one ; and the Veſſels will look like poliſh'd Gold.

And as for ſuch Veſſels, &c. as ſhall be made with Saw-duſt and Gums ; the Varniſh may be made of the ſame Ingredients as above-mentioned, except the Gum Elemi ; and this will dry in the Sun, or in a gentle Warmth.

To varniſh of a Red Colour.

After what you would varniſh has been prepared as before, and are thoroughly dry, mix Vermilion with the third Varniſh, and uſe it warm ; then ſtove it, or harden it by Degrees in an Oven ; and it will appear very gloſſy, or elſe lay on your firſt Ground with Size and Vermilion, and in proper Places you may ſtick on with Gum Arabick, and water ſome Figures cut out of Prints, as little Sprigs of Flowers, or ſuch like, and when they are dry, paint them over with Gold Size, and let that remain, till it is a little ſticky to the Touch ; then lay on your Gold, and let that be well cloſ'd to the Gold Size, and dried. See the Article *Gilding*. Then if you would ſhade any Part of your Flower, take ſome Ox-gall, and with a fine Camels

Camels Hair Pencil, trace over the shady Parts on the Leaf-Gold, and with deep *Dutch* Pink; and when that is dry, use your Varnish in a warm Place (I mean that Varnish directed for the Covering of Gold) and set it to harden by degrees in an Oven, which Varnish will secure the Leaf Gold; altho' it be only that called *Dutch* Gold, or Metal, from changing by keeping the Air from it.

Varnishing any Thing which is covered with Leaf Silver.

First paint the Thing over with Size, and ground Chalk or Whiting; let them stand till they are thoroughly dry, and then do them over with very good Gold Size, of a bright Colour (for there is much Difference in the Colour of it; some being yellow, and others almost white; the first is most proper for Gold, and the last for Silver). When this Size is almost dry, that it will just stick a little to the Touch, lay on the Leaf Silver, and close it well to the Size. See the Article *Gilding*.

A VARNISH for covering Silver.

Melt in a well glaz'd Pipkin, some fine Turpentine, and put in three Ounces of white Amber, finely powdered (more or less, according to the Quantity your Work will require) put it in by little and little, keeping it continually stirring, adding by Degrees some Spirit of

Turpentine, till all the Amber is dissolved, and then add to it an Ounce of *Sarcacolla* well beaten, and an Ounce of Gum *Elemi* well levigated, adding now and then a little Spirit of Turpentine, till all is dissolved: do this over a gentle Fire, and keep it constantly stirring.

This Varnish will be white and strong as the former, and is to be used warm, and hardened by degrees in an Oven, as varnished Gold, and it will look like polished Silver.

VARNISH for Wood, to mix with several Colours.

Take Spirit of Turpentine, and dissolve in it a little Gum *Taccamahacca* over the Fire, till it is a little thickened; and this may be used with any Colour, that has been well ground with Water, and afterwards reduced to a fine Powder. When the Work is done, you may, if you please, varnish over your Piece, with the same Varnish directed for Silver and Wood, Tables, Tea-Boards, or any Thing else, may be done in the same Manner, as is directed for Vessels made of the Paste of Paper and Saw-dust.

Varnishing Prints, &c. with white Varnish so as to bear Water and Polishing.

The Print should be first pasted either on Board or shock Cloth, strained on a Frame; in order to do this well, prepare some stiff Starch: and with a Sponge dipt in Water, or thin Starch

Starch (without any Blue in it) wet the Back of your Print, and if you design to lay it on a board, dip a large Brush in thick Starch, and brush it over the Board as even as possible, and let it dry (or you may lay a Ground of Whiting and Size on the Board first, which will do very well) then repeat it a second Time, and so continue till the Veins or Grain of the Wood is quite filled.

In the last Operation, when the Starch is just laid on, lay your wet Print upon it, as smooth as possible, that there be no Wrinkles, nor Bubbles in it, and press it on close every where, till it lies smooth, and so let it by to dry, which it will be, and fit to varnish in 24 Hours with the following Varnish.

Take *Ichtyocolla*, or *Fish-glue*, or *Isinglass*, two Ounces, and after you have pulled it into small Pieces, boil it in a Pint of Brandy or strong Spirits in a well glaz'd earthen Vessel, till it comes to a strong Glue, which you may know by taking out a little, and exposing it to the Air; it is then fit for your Purpose; but don't fail to make it as strong as you can.

And while it is hot, with a large Brush, brush over the Print as quick as you can, and as smooth and even as may be, set it by for a Day or two, and then do it over again with the same Varnish or Glue, and let it dry again very well; then brush it over with white Varnish at such a Distance from the Fire, that it may not blister;

repeat this two or three Times; then let it stand for a Day or two, and then varnish it over again with the white Varnish the third Time, with two or three Passages of the Brush, then let it stand for three or four Days, and it will be hard enough to be polished, which is to be done with a soft Linnen Cloth and some *Tripoli*, rubbing it very gently, till it is as smooth as may be, and afterwards clear it with Flour and Oil; and then it will appear as clear as Glass; and if at any Time it is sullied with Fly-Shits, you may clean it, by washing it with a Sponge and Water.

The white VARNISH.

Take Gum Sandarach of the clearest and whitest Sort, eight Ounces, Gum Mastick of the clearest Sort, half an Ounce, of *Sarcacolla* the whitest, three Quarters of an Ounce, *Venice Turpentine* an Ounce and a half, Benzoin the clearest one Quarter of an Ounce, white Rosin one Quarter of an Ounce, Gum *Anime* three Quarters of an Ounce. Let all these be dissolved, and mixt in the Manner following.

Put the *Sarcacolla* and Rosin into a little more Spirits than will cover them to dissolve; then add the Benzoin, Gum *Anime* and *Venice Turpentine*, into either a Glass or glaz'd earthen Vessel, and pour on as much Spirits as will cover them an inch; then put the Gum Mastick into a Glass

or glaz'd Vessel, and pour strong Spirits upon them, covering them also about an Inch thick, to dissolve them rightly; then put your Gum *Elemi* in a distinct Vessel as before, and cover it with Spirits to dissolve.

For this Purpose, you need only break the Rosin a little, and powder the Gum *Anime*, *Sarcacolla* and *Benzoin*.

Let all stand three or four Days to dissolve, shaking the Glasses, &c. two or three times a Day, and afterwards put them all together into a glaz'd Vessel, stirring them well, and strain the Liquor and Gums gently; beginning with the Gums, through a Linnen Cloth.

Then put it into a Bottle, and let it stand a Week before you use it, and pour off as much of the clear only, as you think sufficient for present Use.

To paste Prints upon Cloth for Varnishing.

If the Print be put upon a shock Cloth, well strained in a Frame, brush the Cloth over with strong Paste, made with Flour and Water, and immediately brush over the back of the Print with well prepar'd Starch; and then brush the Cloth over with the same Starch, and lay on the Print as smooth as possible, without leaving any Wrinkles or Bubbles in the Paper. This you should take Notice of, that when you have laid your Paper upon the Cloth, they will both together appear flagging, and unstrained; but as soon as they are dry, all will

be smooth, as either of them was at first.

Let them stand so in a dry warm Place for a Day or two, and then you may varnish your Print as before directed, with Glue made of *Icthyocolla*, and then with the white Varnish.

With this Varnish you may mix up any Colour, that has been ground dry, with a Marble, and paint it upon any Figure you have drawn, or upon any Print you have pasted upon your Work; but the varnished Colours should be chiefly put upon the shady.

VARNISH made with Seed Lacca.

Take a Pint of strong Spirit of Wine, put into a Glass Vessel, and put to it three Ounces of Seed *Lacca*, and let them stand together for two Days, shaking them often, then pass it through a Jelly Bag, or a Flannel Bag, made like what is called *Hypocrates's* Sleeve, letting the Liquor drop into a well glaz'd Vessel, and giving the Gums a Squeeze every now and then; when the Varnish is almost out of the Bag, add more, and press it gently till all is strained, and the Dregs remain dry.

Be sure you do not throw the Dregs into the Fire, for they will endanger setting the House on Fire.

Put the Varnish up in a Bottle, and keep it close stoppt, setting it by, till all the thick Parts are settled to the Bottom, which they will do in three or four Day

Days, then pour off the clear into a fresh Bottle, and it will be fit for Use.

As for Varnish made of *Shell-Lacca*, it is not of any great Service, tho' so often recommended, for it will not bear the Polish.

When you lay on your Varnishes, take the following Method.

1. If you varnish Wood, let your Wood be very smooth, close grain'd, free from Grease, and rubb'd with Rushes.

2. Lay on your Colours as smooth as possible, and if the Varnish has any Blisters in it, take them off by a Polish with Rushes.

3. While you are varnishing, keep your Work warm, but not too hot.

4. In laying on your Varnish, begin in the Middle, and stroke the Brush to the Outside, then to another extreme Part, and so on till all be covered; for if you begin at the Edges, the Brush will leave Blots there, and make the Work unequal.

5. In fine Works use the finest *Tripoli* in polishing: do not polish it at one Time only; but after the first Time, let it dry for two or three Days, and polish it again for the last Time.

6. In the first polishing you must use a good deal of *Tripoli*; but in the next a very little will serve; when you have done, wash off your *Tripoli* with a Sponge and Water; dry the Varnish with a dry Linen Rag, and clear the Work, if a white Ground, with Oil

and Whiting; or if black, with Oil and Lamp-Black.

An Useful VARNISH.

Take drying Linseed Oil, set it on the Fire, and dissolve in it some good Rosin, or (which is better, but dearer) Gum-lacca; let the Quantity be such as may make the Oil thick as a Balsam. When the Rosin or Gum is dissolved, you may either work it off it self, or add to it some Colour, as Verdigrase, for a green; or Amber, for an Hair Colour; or Indico and White, for a light Blue.

This will secure Timber-work done over with it, equal to painting with Colours in Oil, and is much more easy to obtain; for Linseed Oil and Rosin are more easily melted together, by boiling, than Colours can any ways be ground; and being of the Consistence of a Balsam, works very readily with a Brush, and of it self, without the Addition of Colours; bears a Body sufficient to secure all manner of Timber Work, equal to most Oil Colours.

In the working of it, there's no great Skill required, if you can but use a Painter's Brush; only let the Matter you lay it on, be thoroughly drenched, that the Outside may be glaz'd with it: And if you desire a Colour on the Outside, you need only grind a Colour with the last Varnish you lay on.

To preserve bright Iron-work from Rust, and other Injuries of a corroding Air, by an oily Varnish.

Take good *Venetian*, or for want of that the best and clearest common Turpentine, dissolve it in Oil of Turpentine, and add to it some Linseed Oil, made clear by long standing in the hot Sun (for some uses the common drying Linseed Oil may serve;) mix them well together, and with this Mixture varnish over any Sort of bright Iron-work whatsoever.

It is a certain Preserver of all such Iron-work from Rust, let it be what it will, provided it be such as is not brought into common Use, for much handling will wear it off, and Heat will dissolve it; but for all such bright Iron-work that is used about either Carpenters or Joiners Work, that require not much handling; as also Arms, &c. that hang up for State, rather than present Use, it is an infallible Preservative.

When you use this oily Varnish, 'tis best to warm it, and then with a Brush lay it on as thin as possible; this is best for Arms; but for other Iron-work, it may be laid on cold; in four or five Days after it has been laid on, it will be thoroughly dry.

Note, That such Arms as have been done over with it, may when they come into use be cleansed from it again, by being warmed hot before a Fire: for Heat will dissolve it, but

Water will do it no Hurt.

VASES [in *Architecture*] are certain Ornaments placed on Cornices, Socles or Pedestals; representing the Vessels of the Ancients; particularly those used in Sacrifices, as Incense Pots, Flower-Pots; all which are occasionally enrich'd with *Basso Relievo's*.

They are usually placed there to crown or finish Facades, or Frontispieces.

Vitruvius speaks of a Sort of Theatrical Vases made of Brass, or earthen Ware, which were disposed in private Places, under the Steps and Seats of the Theatres, to aid and increase the Reflection and Resonance of the Actors Voices, &c.

It is said there are of these Sort of Vases in the Cathedral Church of *Milan*.

VASE is particularly used in *Architecture*, to signify the Body of the *Corinthian* and Composite Capital, and is called the Tambour or Drum, and sometimes the *Campana*.

VAULT [in *Architecture*] is a Piece of Masonry-Arch without Side, and supported in the Air by the Artificial placing of the Stone which forms it, its principal Use being for a Cover or Shelter, or it is an arch'd Roof, so contriv'd, as that the several *Voussairs* or Vault-Stones, of which it consists, do, by their Disposition sustain each other. Vaults are to be preferred on many Occasions to *Soffits* or flat Cielings, as they give a greater Rise and Elevation, and besides are more firm and durable.

Salmasius observes, that the Ancients had only three kinds of Vaults. The first was the *Fornix* made Cradle-wise; the second, a *Testudo*, i. e. *Tortoise*-wise, which the *French* call *Cul de Four* or *Oven-wise*; and the third, *Concha*, or *Trumpet*-wise.

But the Moderns have subdivided these three Sorts into many more, to which they have given different Names, according to their Figures and Uses, some of them are circular and others elliptical.

Again, the Sweeps of some are larger, others less Portions of a Sphere. All such as are above Hemispheres are called *High* or *surmounted Vaults*; and all that are less than Hemispheres, are called *Low* or *surbased Vaults*, or *Testudines*.

In some *Vaults* the Height is greater than the Diameter; in others, it is less: others again are quite flat, and only made with Haunses, others like Ovens, or in the Form of a *Cul de Four*, &c. and others growing wider as they lengthen, like a *Trumpet*.

There are also *Gothick Vaults*, with *Ogives*, &c.

Of *Vaults* some again are *single*, others *double*, *cross*, *diagonal*, *horizontal*, *ascending*, *descending*, *angular*, *oblique*, *pendent*, &c.

Master *Vaults* are those that cover the principal Parts of Buildings, in contradistinction to the upper or subordinate *Vaults*, which only cover some little Part, as a Passage or Gate, &c.

A *double Vault* is one that is built over another, to make the outer Decoration range with the inner, or to make the Beauty and Decoration of the Inside, consistent with that of the Outside, leaves a Space between the Concavity of the one, and the Concavity of the other. Instances of which, we have in the Dome at *St. Peter's* at *Rome*, *St. Paul's* in *London*, and in that of the Invalids at *Paris*.

Vaults, with Compartments, are such whose Sweep, or inner Face is enrich'd with Pannels of Sculpture, separated by Platbands. These Compartments, which are of different Figures, according to the *Vaults*, and usually gilt on a white Ground, are made with Stone or Brickwalls; as in the Church of *St. Peter* at *Rome*, or with Plaster on Timber *Vaults*.

Theory of Vaults.

A *Semi-circular Arch* or *Vault*, standing on two *Piedroits*, or *Imposts*, and all the Stones that compose them, being cut, and placed in such Manner, as that their Joints or Beds being prolonged, do all meet in the Centre of the *Vault*; it is evident, that all the Stones must be in the Form of *Wedges*, i. e. must be wider and bigger at Top, by virtue of which they sustain each other, and mutually oppose the Effort of their Weight, which determines them to fall.

The Stone in the middle of the *Vaults*, which stands perpendicular

pendicular to the Horizon, and is called the *Key* of the Vault, is sustained one each Side by two contiguous Stones, just as by two inclin'd Planes; and consequently the Effort it makes to fall, is not equal to its Weight.

But still that Effort is the greater, as the inclin'd Planes are less inclin'd; so that if they were infinitely little inclin'd, *i. e.* if they were perpendicular to the Horizon, as well as the Key, it will tend to fall with its whole Weight, and would actually fall, but for the Mortar.

The second Stone, which is on the right or left of the *Key-Stone*, is sustained by a third, which by virtue of the Figure of the Vault, is necessarily more inclined to the second, than the second is to the first; and consequently the second, in the Effort it makes to fall, employs a less Part of its Weight than the first.

For the same Reason, all the Stones from the *Key-Stone*, employ still a less and less Part of their Weight to the last; which resting on a horizontal Plane, employs no Part of its Weight; or which is the same Thing, makes no Effort at all, as being intirely supported by the Impost.

Now in *Vaults*, a great Point to be aimed at, is, that all the *Vouffoirs* or Stones make an equal Effort towards falling: To effect this, it is visible, that as such (reckoning from the *Key* to the Impost) employ still a less and less Part of its whole

Weight; the first, for Instance only employing one half, the second, one third, the third one fourth, &c. There is no other way of making those different Parts equal, but by a proportionable Augmentation of the whole, *i. e.* the second Stone must be heavier than the first, the third than the second, &c. to the last; which should be infinitely heavier.

M. de la Hire demonstrates what that Proportion is, in which the Weights of the Stones of a Semi-circular Arch must be increased to be in *Equilibrio*, or to tend with equal Forces to fall, which is the firmest Disposition a Vault can have.

The Architects before him had no certain Rule to conduct themselves by, but did all at Random. Reckoning the Degrees of the Quadrant of a Circle, from the Key-stone to the Impost, the Extremity of each Stone will take up so much the greater Arch, as it is farther from the Key.

M. de la Hire's Rule is to augment the Weight of each Stone above that of the Key-stone, as much as the Tangent of the Arch of half the Key.

Now the Tangent of the last Stone of Necessity becomes infinite, and of consequence its Weight should be so too; but as Infinity has no Place in Practices, the Rule amounts to this, that the last Stones be loaded as much as possible, that they may the better resist the Effort which the Vault makes to separate them; which is call'd the Shoot or Drift of the Vault.

Mr. *Parent* has since determined the Curve or Figure, which the *Extrados* or Outside of a Vault, whose *Intrados* or Inside is spherical, must have that all the Stones may be in *Equilibrio*. See *Bridges*.

The Key of a Vault is a Stone or Brick in the middle of the Vault, in Form of a truncated Cone; which serves to bind or fasten all the rest.

The Reins of a Vault, or the filling up are the Sides which sustain it.

The Pendentive of a Vault is the Part suspended between the Arches or *Ogives*.

The Impost of a Vault is the Stone on which the first *Voussoir* or Stone of the Vault is laid.

VELOCITY [in *Mechanicks*] *i. e.* Swiftneſs, is that Affection of Motion, whereby a Moveable is diſpoſed to run over a certain Space in a certain Time.

The greateſt Velocity where-with a Ball can deſcend, by virtue of its ſpecifick Weight, in a reſiſting Medium, is that which the ſame Ball would acquire by falling in an unreſiſting Medium thro' a Space, which is to be four Thirds of its Diameter, as the Denſity of the Ball to the Denſity of the Fluid. *Huygens, Leibnitz, Bernouli*, and other foreign Mathematicians, hold, that the *Momenta*, or Forces of falling Bodies, at the End of their Falls, are as the Squares of their Velocities into the Quantities of Matter. On the contrary, the *Engliſh* Mathematicians maintain them

to be as the Velocities themſelves into the Quantities of Matter. Velocity is conceived to be either abſolute or relative: The Velocity which has been already conſidered is ſimple or abſolute, in reſpect to a certain Space, mov'd in a certain Time.

Relative or reſpective Velocity, is that wherewith two diſtant Bodies approach each other, and come to meet in a longer or leſs Time; whether only one of them moves towards the other at reſt, or whether they both move; which may happen two ways, either by two Bodies mutually approaching each other in the ſame right Line, or by two Bodies moving the ſame Way in the ſame Line, only the foremoſt ſlower than the other; for by this means this will overtake that, and as they come to meet in a greater or leſs Time, the relative Velocity is greater or leſs.

Thus if two Bodies come nearer each other by two Feet, in one ſecond of Time; their reſpective Velocity is double that of two others, which only approach one Foot in the ſame Time.

VENEERING is a Sort of **VANEERING** of Marquetry, or inlaid Work, whereby ſeveral thin Slices, or Leaves of fine Woods of different Kinds, are applied and faſtened on a Ground of ſome common Wood.

There are two kinds of inlaying; the one which is the more ordinary, goes no farther than

than the making Compartments of different Woods ; the other requires a great deal more Art, and represents Flowers, Birds, and the like.

The first kind is what we properly call Veneering, the latter is described under the Article Marquetry.

The Wood intended for Veneering is first sawed out into thin Slices or Leaves, about a Line thick ; in order to saw them, the Blocks or Planks are placed upright, in a kind of Sawing Press.

These Slices are afterwards cut into narrow Slips, and fashioned divers ways, according to the Design proposed : After this the Joints are carefully adjusted, and the Pieces brought down to their proper Thickness, with several Plans for that Purpose ; then they are glued down on a Ground or Block of dry Wood, with good strong *English* Glue.

The Pieces being thus jointed and glued, the Work, if small, is put into a Press ; if large, it is laid on a Bench covered with a Board, and press'd down with Poles or Pieces of Wood, one End of which reaches to the Ceiling of the Room, and the other bears on the Board.

When the Glue is thoroughly dry, they take it out of the Press and finish it ; first with little Planes, afterwards with divers Scrapers ; some of which resemble Rasps which take off the Dents, &c. left by the Planes.

When the Work has been

sufficiently scraped, it is polished with the Skin of a Sea-dog, Wax and a Brush, and a Polisher of Shave-grass ; which is the last Operation.

VENTIDUCTS [in *Building*] or Spiracles or subterraneous Places, where fresh cool Winds being kept, are made to communicate, by means of Ducts, Funnels, or Vaults, with the Chambers or other Apartments of an House, to cool them in sultry Weather. These are called by the *Italians*, *Ventidetti*, and by the *French*, *Prisons des Vents*, and *Palais d'Eole*.

VERDEGREASE is the best and most useful green of all others ; this Colour is made out of Copper, being no other than the Rust of that Metal, promoted by the Fumes of sour Wine, and the Rape of Grapes ; the Process of which, as it is perform'd at *Montpelier*, in *France* (where the best is said to be made) as may be seen in Mr. Ray's Travels, pag. 454. It is a delicate Green inclining to a bluish ; but with a little Pink-yellow, makes the delicatest Grass-green in the World, It is a Colour that will grind very fine ; but not without some Pains ; and when ground fine, it lies with a good Body, and works well.

They have at the Colour-shops a Sort of it, that they call distill'd Verdegreafe, being that which is perfectly purified from Dross and Filth, of good Use in fine Work, but too dear for common Painting.

Green VERDITER is a sandy Colour, and does not bear a good Body, and is seldom used but in Landskip, where Variety is required. It should be washed before used. See washing of Colours.

Blue VERDITER is something sandy, of no very good Colour, of it self, nor no good Body, being apt to turn greenish; but being mix'd with yellow, makes a good green. It ought to be washed before used. See washing of Colours.

VERMILION is the most delicate of all light Reds, being of it self a perfect Scarlet Colour; it is made artificially out of Quick-silver and Brimstone, in the manner following.

Take six Ounces of Brimstone, and melt it in an Iron Ladle, then put two Pound of Quick-silver into a shammy Leather, or double Linnen Cloth, and squeeze it out into the melted Brimstone, stirring them, in the mean Time, with a wooden *Spatula* till they are well united; and when they are cold, beat the Mass into a Powder, and sublime it in a Glass-vessel, with a strong Fire, and it will rise into that Red Substance, which is called artificial Cinnabar or Vermilion. The whole Process may be seen more at large in *Lemery's Chymistry*.

This Colour is of a delicate fine Body, and if Pains be bestowed on it, it will grind as fine as the Oil it self, and then it makes a most excellent Colour: But if it be not ground

very fine, the Glory of it will not appear; for it will look dull, and work coarse; but if it be ground very fine, no Colour in the World looks better or works smoother, nor bears a better Body than Vermilion does, nor goes farther.

VERTEX the Top of any Thing, as the Vertex of a Cone, Pyramid, Conick Section, &c.

VERTEX [of a Glass in Opticks] is the same with the Pole of the Glass.

VESTIBLE [in *Architecture*] a kind of Entrance into large Buildings; being an open Place before the Hall, or at the Bottom of the Stair-Case.

VESTIBLES only intended for Magnificence, are usually between the Court and the Garden: These are sometimes *simple*, i. e. have their opposite Sides equally enrich'd with Arches; and sometimes their Plan is not contained under four equal Lines, or a circular one, but forms several *Van Corps*, and *Rear Corps*, furnished with Pilasters, &c.

The *Romans* had Places called Vestibles, at the Entrance of their Houses, for the Shelter of those Persons who were obliged to stand at the Door. And we have now Vestibles of the like Kind in many old Churches, Houses, &c. called *Porches*.

Martinius derives the Word from *Vestæ stabulum*, by reason that the Fore-part of the House was dedicated to *Vesta*, and others say, because it was usual for People to stop in the Vestible before they went in Doors.

Daviler derives it from *Vestis*, a Garment, and *ambulare*, to walk, because the *Vestible* in the modern Houses being an open Place at the Bottom of a large Stair-case, serving as a Thorough-fare to the several Parts of the house; here they first let fall their Trains in Visits of Ceremony.

Vestible is also sometimes used to signify a little kind of Antichamber before the Entrance of an ordinary Apartment.

VIBRATION [in *Mechanicks*] is a regular, reciprocal Motion of a Body, *e. gr.* of a Pendulum; which being suspended at Freedom, swings or vibrates first this Way, and then that.

For the Bob being raised, falls again by its Gravity, and with the Velocity thus acquir'd, rises to the same Height on the other Side; from whence its Gravity makes it fall again; and thus its Vibrations are continued.

Mechanical Authors, instead of Vibration, frequently use the Term *Oscillation*.

The Vibrations of the same Pendulum are all *Isochronal*, *i. e.* they are performed in equal Time, at least in the same Climate; for towards the Equator they are somewhat slower.

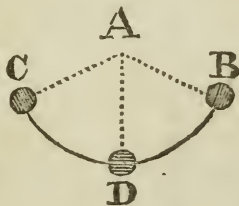
A Pendulum three Foot three Inches, and two Tenths of an Inch, according to *Huygens*, or 39.25 Inches, according to Sir *John Moor* and Lord *Brouncker*, vibrates Seconds, or makes 3600 Vibrations in an Hour.

The *Vibrations* of a longer Pendulum take up more Time than those of a shorter one, in a sub-duple *Ratio* of the Lengths.

Thus a Pendulum three Foot long, will make 10 *Vibrations*, while another nine Inches long, makes 20: for 10 is the half of 20, and three Feet, or 36 Inches, are the Square of six Inches, which is the double of three, whose Square is nine: So that 10 is to 20 in a sub-duple *Ratio* of 36 to 9.

The same is meant, when we say, that the Number of *Vibrations* of *Pendulums* in a given Time, is in a reciprocal *Ratio* of their Lengths.

VIBRATION is the circular Motion of a Body, as B or C swinging on a Line, &c. fastened at A as a Center, which Point A is called the Center of Motion, and by some, the Center of reciprocal Motion; the Point D is called the Point of Rest, and a Line A B is called the Pendulum.



A is called the Center of reciprocal Motion, because when the Pendulum A D is moved from the Point of Rest D to C, it moves about that Point A to return to D, first on the one Side, and then on the other, until by its own Gravity, it

ceases its Motion, and remains in D the Point of Rest : wherefore 'tis called the Center of reciprocal Motion.

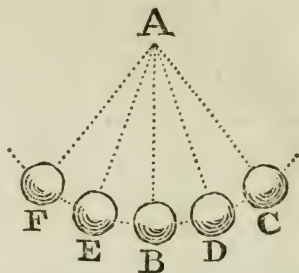
Vibration is either *simple* or *compound* ; that is *simple*, when the Pendulum has moved from B to C, and *compound* when it has returned back again from C to B, &c.

Pendulums of equal Lengths and Weights, perform their Vibrations very near in the same Time ; but *Pendulums* of different Lengths will vibrate unequally, because a longer *Pendulum* must remove more Air in its Swing or Vibration than a shorter.

It has been found by several Experiments, that the Length of two unequal Pendulums are reciprocally proportionable to the Squares of the Numbers of their Vibrations ; that is the Length of the first Pendulum : is to that of the second :: as the Square of the Numbers of the Vibrations of the second : in a given Time : is to the Square of the Numbers of the Vibrations of the first in the same Time.

Mr. *Henry Philips* in his Advancement of the Art of Navigation, affirms, 'That if a Pendulum be made = 38 Inches and a half from A the Center of Motion, to C the Center of Gravity of a Bullet, &c. every Vibration of such a Pendulum will be = one Second or both Parts of a Minute of Time : that is every Time that the Body C or D passes by the Point of Rest B, either from B to C, and back again to B,

or by the Point of Rest B, either from B to C, and back again to B, or from B to F, and back again to B, will be = one Second of Time, and consequently its Motion from C to B, or from B to F, &c. must be = half a Second of Time.



Here it is to be observed, that it is no Matter what Swing or Distance from the Point of Rest you first give it ; for a Body will vibrate in the same Time from C to F, as from D to E.

Therefore if several Pendulums of equal Lengths and Weights were set going together at the same Time, with Difference, at first they would be all in perpendicular Position, as A B at the same Time.

For tho' the Body C, being raised higher from B than the Body D, will vibrate with greater Velocity than the Body D, which is raised but half the Height of C. Yet if both Sides are set going at the same Time, they will pass by the Point of Rest at the same Time, their Velocity being proportionable to the Spaces through which they pass,

This is plain; for as the Body D vibrates but to E, which is but half the Arch C F, thro' which the Body C vibrates at the same Time: therefore the Body D requires but half the Velocity of the Body C, &c.

VICE [in *Smithery*, &c.] is a Machine or Instrument serving to hold fast the Pieces to be filed, bent, riveted, &c.

The Parts of the Vice are the Plane, which is its uppermost Part; the Chaps which are cut with Bastard Cut, and well tempered; the Screw-pin, cut with a square strong Worm; the Nut or Screw-box, which has a square Worm, and is braz'd into the round Box, the Spring which throws the Box open, and the Foot on which the whole is mounted.

VICE [with Glaziers] a Machine for turning or drawing Lead into flat Rods, with Grooves on each Side, to receive the Edges of the Glass.

VISION [in *Opticks*] the Laws of Vision brought under Mathematical Demonstration, make the Subject of Opticks taken in the greatest Latitude of that Word: for among the Writers of Mathematicks, Opticks is most generally taken in a more restrained Signification for the Doctrine of direct Vision; Catoptricks for the Doctrine of reflected Vision; and Dioptricks for that of refracted Vision.

Direct VISION } is that
Simple VISION } which is performed by means of direct Rays; that is of Rays passing directly, or in right Lines, from

the radiating Point to the Eye.

Reflected VISION is that which is performed by Rays reflected from *Specula* or Mirrors.

Refracted VISION is that which is performed by Means of Rays refracted or turned out of their Way, by passing thro' Mediums of different Density, chiefly thro' Glasses and Lenses.

VISUAL RAYS are Lines of Light imagined to come from the Object to the Eye.

VISUAL Point [in *Perspective*] is a Point in the horizontal Line, wherein the ocular Rays unite. Thus a Person who stands in a straight long Gallery, and looking forwards, the Sides, Floor and Ceiling seem to meet, and touch one another in a Point or common Center.

VIVO [in *Architecture*] the Shaft or Fust of a Column; it is also used for the naked of a Column.

UMBER is a Colour of great Use in vulgar Painting; it is an Earth or Mineral dug out of a certain Island in the Mediteranean Sea, being of the Complexion of that which among us is called a Hair Colour; it grinds very fine, and bears the best Body of any earthy Colour, now in use, and when burnt, becomes the most natural Shadow for Gold of all others, and with a Mixture of white, it resembles the Colour of new Oaken Wainscot; it dries quickly and with a good Gloss,

Umber if it be intended for the Colour of a Horse, or a Shadow for Gold, then burning fits it for that Purpose, by making it darker.

It must only be put into the naked Fire in large Lumps, and not taken out till they be thoroughly red hot, or you may, if you please inclose it in a Crucible, and then put it into the Fire till it be red hot, and then take it out, and when cold lay it by for Use.

UNDER PINNING [in *Building*] signifies the bringing it up with Stone under the Groundsells. Sometimes it is used to signify the Work itself when it is done.

[*The Price of doing it.*] The Price in several Parts of *Suffex* (for the Workmanship only) in some Parts of *Kent*, is 1 d. $\frac{1}{2}$ per superficial Foot, and in *Suffex* 1 d. per Foot.

In some Places, 'tis the Custom in measuring it, to take in half the Shell into their Measure.

UNGULA [in *Geometry*] is the Section of a Cylinder cut off by a Plane, passing obliquely through the Plane of the Base, and Part of the Cylindrical Surface.

VOLUTE [in *Architecture*] is a Sort of Scroll or Spiral Contortion used in the *Ionick* and composite Capitals, of which it is the principal Character, and Ornament.

It is by some called the *Ram's horn*, from the Resemblance of the Figure thereto.

Most Architects are of the Opinion, that it was designed

by the Ancients, to represent the Bark or Rind of a Tree laid under the *Abacus*, and twisted thin at each Extreme where it is at Liberty: others suppose it to be a Sort of a Pillow or Bolster laid between the *Abacus* and *Echinus*, to prevent the latter from being broke by the Weight of the former, and the Entablature over it, and accordingly call it *Pulvinus*. Others, after *Vitruvius*, suppose it to represent the Curls or Tresses of a Womans Hair.

There are also eight angular Volutes in the *Corinthian* Capital, accompanied with eight other smaller ones, called *Helices*.

There are several Diversities in the *Volute*.

In some the List or Edge is in the same Line or Plane throughout all the Circumvolutions: such are the antique *Ionick* Volutes, and those of *Vignola*.

In others, the Spires or Circumvolutions fall back, and in others they project or stand out.

Again, in some, the Circumvolutions are oval: in others, the Canal of one Circumvolution is detached from the List of another, by a Vacuity or Aperture.

In others the Round is parallel to the *Abacus*, and springs out from behind the Flower of it.

In others it seems to spring out of the *Vase* from behind the *Ovum*, and rises to the *Abacus*, as in most of the fine composite Capitals.

Consoles, *Medillions*, and other

ther Sorts of Ornaments, have likewise their *Volutes*.

The *Volute* is a Part of great Importance to the Beauty of the Column. Hence Architects have invented divers Ways of delineating it.

The Principal are that of *Vitruvius*, which was long lost; and restored by *Gouldman*; and that of *Palladio*. *Daviler* prefers the former as the easier.

VOUSSOIR [in *Architecture*] a Vault-stone, or a Stone proper to form the Sweep of an Arch, being cut somewhat in manner of a truncated Cone, whose Sides, if they were prolong'd, would terminate in a Center, to which all the Stones of the Vault are directed.

VOUSSOIRS. See the Article *Bridges*. Also see the *Plate*.

The Figures 1 and 2, represent the Voussloirs of an Arch, and their Names, *viz*.

1. Is the Couffinet, or prime Voussloir, which is the first Stone of an Arch, from whence the Rise of the Center commences.

2. 2. 2, &c. The Voussloirs from the Head of a Bridge, and Haunses of a Vault or Arch.

3. The Key-stone, upon which, usually, are carved the Arms of him to whom the Bridge belongs, or who caused it to be erected.

A B C, the *Extrados*.

6, 8, 9, The *Extrados* and *Douelle*, *i. e.* the interior Surface of a Stone, or facing of an Arch, and Part of the Curve within one Voussloir; which in the Arch of a Bridge is some-

times also called the *Intrados*.

5, 6, The Bed of the *Douelle*.

6 and 1, The Joint of the Face or the Head.

5 and 6, The Joint of the *Douelle*.

A, 2, 8, The Height of the Retombe, which is the Position of every Stone in the Voussloir, which is laid upon the first, and is called the Couffinet of an Arch, which thence begins to form its Rise, and which being laid by themselves can subsist without a Center.

Figure 2. Represents the Empalement [*i. e.* the greatest Thickness of a Foundation of Piles] of a Foundation, from its Commencement, to which, at LH is given one fourth of the Height LM, when the Bottom LD is of a sufficient Consistence; and on the contrary, when the Bottom is doubtful; it is given one Third, or the half of LI of the Height of LM, with the Retraites.

CE proportional to the largeness of the Empalement.

The larger the Arches are of a Bridge that is projected, the larger must be the Piers and Abutments, and also the Voussloirs must be enlarg'd in Proportion.

We have indeed no certain Rule for determining the Size of the Voussloirs of Arches, we can only take our Models from those Works which have been done, and especially of the most experienc'd antient Architects, and thence to frame a Rule for the proportioning the principal Materials, on which consists

consists almost the whole Force of Arches and their Arrangement.

I have says M. *Gautier* observ'd the Works of the *Romans*, the Extrados Voussoirs being four Feet from the Tail to the Arches, which had ten Toises in the Opening, and that the same Voussoirs had in Length in the Bed, four Foot and a half, and 15 Inches in Thickness at the hollowed or concave Part of the Inside of a Voussoir; and that the Thickness from the Arch to the Key might be five Foot.

Upon this Foot may be fram'd a Rule of Proportion for all Sorts of Semi-circular Arches; so that if one follows the Rule of the antique Arch of *Pont du Gard*; we shall find that if an Opening of ten Toises of an Arch give four Feet for the Tail of a Voussoir; that five Toises will give but two Foot; and 15 Toises, six Feet; 20 Toises, eight Feet, and in fine, 25 Toises, 10 Feet.

But I would not follow the same Proportion in Arches of five Toises below; because this would reduce the Voussoir of an Arch of one Toise, opening to six Inches in the Tail, instead of one Foot and a half, which it ought to have.

So that if we compare a Voussoir of one Foot and a half in the Tail, for an Arch of one Toise wide, with one of two Foot in the Tail for an Arch of five Toises wide, the Rule will be better followed and better proportion'd in Respect to the Force or Strength

of the Materials and their Bearing.

It is certain that a large Bridge that bears a large Carriage, is less loaded than a small Bridge that bears the same Carriage. Therefore in the last the Voussoirs ought to be proportioned to the Weight of the Carriages that pass over them, and not to the Materials with which they are built, which they ought to support, and which are not very heavy.

If the Weight of Carriages were diminish'd in Proportion to the largeness of the Bridges over which they pass, the first Rule of Proportion might be observ'd; but as it is augmented in Proportion to what is done in smaller Arches, the Voussoirs ought to be made proportional to the Weight they are to support, and not to those of large Arches, where the same Weight is but one Point in Respect to their Solidity and Mats.

It is also certain that Materials of more or less Consistence, will contribute more or less to the Solidity of these Works; that Voussoirs of three Foot in the Tail that are compact and close, will render an Arch of ten Toises opening more secure, than those of four Feet, which shall be of less Consistence; by Reason of their being made of more tender or soft Stone; and from *Physicks* it is that this Knowledge is to be gained, I am of Opinion says M. *Gautier*, that if these kinds of Proportions were followed, we should not fall into those

those Errors which are every Day committed by those who are well acquainted with this Work.

I shall give an Example of a Bridge, which Decency hinders me from naming.

The Arch fell down; it was 12 Toises in the Aperture, and the Vouffoirs, altho' the Stones were very tender, had besides this, the Fault of having too little Tail to retain them; not at all proportion'd to the Rule aforesaid.

As it is only the Vouffoirs that keep the Work together, and the Masonry that is ordinary above them, is laid on the Level, according to the Courses of the Facades of the Bridges, it is certain that these Courses do nothing but over-burden the Vouffoirs, and that the Surplussage of Masonry, is only proper for the compleating the Breaking of the Arch, and not for the Easing it.

I was call'd to give my Advice upon the falling of this Arch, I found that the Cut of those Stones in Respect to the Scheme Arch Centre, was well perform'd, nevertheless the Work was exclaim'd against as deficient in that Point. But in the End I assur'd them, that to re-establish this Bridge, the Bounding Vouffoirs ought to have a greater Length than they had made them, and that they ought to be of Stone of a stronger Consistence; and the Work being perform'd after this Manner, succeeded perfectly well.

It is certain (adds he) that

Paris furnishes the most accomplish'd Architects in Europe; the Precautions that have been taken at the *Pont Royal* of the *Tuileries*, in the Position of the Vouffoirs whose Tails are without End, and which have been prolonged since the Falling of the Arches, mounting up towards the Key, as one may say to the Cordon or Plinth, and as far as to the Superficies of the Pavement, or above all, there is nothing but *Vouffoir en Coupe*, according to the *Epure* of the Arches, seen at the Head for about a third Part of the Arch, all over the Place where the greatest Effort is made.

These Vouffoirs *en Coupe* are lengthened at the End of their Tails, following the same Cut.

It is not because the Vouffoir is intire, that it secures the Work the better; it is its Length and its bearing on the Reins of the Arch which bind it and keep it in Place; when Bridges are not extradossed, and the Cut is adjusted to perfect the whole.

A Vouffoir may be easily prolonged, provided its Cut be follow'd in its prolongation, and there be no Void between them; and they may be secur'd by Cramping Irons, if you please.

My Advice, (says M. *Gautier*) is to lay them all dry, the one against the other in Courses, after the Manner of the Ancients, and not to lay them in fine Mortar, but by the Abbreuvement strained and put in.

In the fine Works of the Ancients we see that the greatest

Part of the Vaults, Arches and Arcades, and Arches built with large Blocks of hewn Stone; they neither us'd Mortar nor Cramp-Irons, and that all there was dry; they did not use Mortar in any but Vaults and Arches made of Shards, rough or unhewn Stones: The Mortar does not fasten and assure the Work but in the uniting of small Materials and large Blocks of Stone, are superior to the Feebleness of Mortar; the large Vouffoires of Bridges are not sustain'd and secur'd, nor the Work, but by their own proper Weight join'd to the Cut, which prevents them from disuniting; and this very same Weight, which is most often the Cause of the Ruin of the largest Buildings, is in Bridges the only Cause that secures them, and without which one cannot succeed.

It is not at all surprizing if the *French* Companions Stone-Cutters having penetrated beyond *Egypt*, the whole Length of the *Nile*, beyond some of their Cataracts and frightful Water-Falls, and having made a Stone-Bridge in one of the Places of this River, very narrow between two Rocks; they were esteem'd as Demi-Gods.

The People of these Countries, very ignorant, but very docile, mock'd at the Enterprize of the *French*, but the Work being finish'd, they came from the Parts round about to cross the *Nile* on this Work, not being able to comprehend that Stones thus set in Order, the one against the other, could

be born up, and even as it were hang in the Air. In Reality it is the Cut of the Stones that is the Soul of all the Vaults and of all the Stone-Bridges, and ought to be look'd upon as the principal Foundation of their Construction.

There are Bridges made all of Brick; they do in some of them, for Neatness, Security and Decoration, make *Arretes* and *Encoignures* of hewn Stone.

That of *Thoulouse* may serve for an Example. The Bricks are laid equally in Cut to the hewn Stone, making it follow the Tract of the [Epure] Plinth or Fascia, that has been trac'd. This they take Care on, that they be well burnt, and the Mortar good and fine, and that they may be assur'd of the Lime, to the End that it may soon lay hold.

There are also seen at *Montauban* and at several other Cities of *Languedoc*, Bridges made all of Brick, Houses, Churches, Steeples and other magnificent Works made of Brick.

The first Works of the earliest Ages were made of Brick, the *Jews* taken Captives; after they had lost their Liberty, were employ'd in Brick-making.

In Bridges either of Brick-work or Masonry, the Materials ought to be expos'd to the Air and Rain for the Space of a Year; that is to say, one Winter and one Summer; and all at the End of that Time ought to be reject'd, either Brick or Stone, that have not under-

undergone the Proof of the Heat of the Summer, and the Frost of the Winter; and the Inspectors of Works ought to cause them all to pass in Review the one after the other; and immediately break off the the Corners of all those that are not Proof.

Too great Precautions can't be taken in Works of such Consequence, which very often can't be remedied when once done.

The greatest Works of the first Men were built with nothing but Brick: the Tower of *Babel* and the Walls of *Babylon* were built only with Brick; and the Bricks are found as found as they were the first Day they were laid there: For Mortar they us'd nothing but *Spaltum*, a Sort of Bitumen which they brought from a neighbouring Lake, and as some say, they mix'd Straw with it between the Joints of the Bricks to make a binding, which yet is seen intire, if with a Hammer a Piece of Brick is broken off with the Cement, if we believe what those who have travelled to those Parts have related.

When the Arches of one and the same Bridge have been larger the one than the other, and yet the Keys of the same Height; they have not brought them upon a Level, but in establishing the first Rises of the biggest Arches in the Piers below those of the smallest in Proportion to their Size.

They always also made their Arches Semi-circular, and ra-

ther than to sink them by *Ellipses*, they rather chose to use one Portion of a great Arc, as has been observ'd of the *Pont du Gard*.

The *Goths* who succeeded to the good Gust of the *Roman* Architecture, made Bridges in many Parts of *France*, with *Gothic* Arches, *i. e.* of the *Third Point*, as certainly pretending by that to make less Push; both in their publick Buildings and Bridges, we see in many Places, and also in private ones; and also in those Churches which we see that were built in their Time. These *Gothic* Arches rise most in Bridges.

The Moderns on the Contrary by a Change and Novelty, common to all Ages, have fallen into *Elliptical* Arches; in Order to diminish the Ramp of Bridges, and by that Means to facilitate the Ascent of heavy laden Carriages.

One time or other, Change in these Things will come, when they will put on another Mode, according to the Humour of those Times.

Men begin to admire Scheme Arches, and yet Plat-Bands more; in fine, all that is the most compos'd where Nature is the most forc'd, or in which there is the most Labour, or the Art of which is the most surprizing, is what is at this time most in Fashion.

Of these three Manners of Arches, it may be said that that which is of the *Third Point* or *Gothic*, is capable of bearing a greater Load than a Semi-circular Arch; and a Semi-

Semi-circular than a Scheme Arch or an Elliptical one; the first is the most elevated or highest; the second is lower, and the last is the most Rampant and lowest.

Both the one and the other augment or diminish their Pulses in Proportion to their Disposition, and of Consequence they are differently us'd.

I have given upon the one and the other a Dissertation, which proves and demonstrates their Efforts more or less, to determine the Thickness of the Abutments which must sustain or keep them in, and the Piers which are to support them.

Thus far *M. Gautier*. See the Article *Bridges*.

UPRIGHT [in *Architecture*] is a Representation or Draught of the Front of a Building, call'd also an *Elevation*.

URN [in *Architecture*] a kind of Vase of a roundish Form, but biggest in the middle like the common Pitchers; now seldom us'd but as Ornaments, over Chimney-Pieces, Buffets, &c. or by way of Acroter's, a Top of Buildings, Funeral Monuments, &c. or

Serving as a Crowning over Ballustrades, and as an Attribute to Rivers, River-Gods, &c. in the Grotto's and Fountains in Gardens.

A Funeral Urn is a kind of cover'd Vase, enrich'd with Sculpture, and serving as the Crowning or finishing of a Tomb, a Column, a Pyramid, or other Funeral Monument, made in Imitation of the An-

cients, who deposited the Ashes of their deceas'd Friends in this kind of Urn.

W.

WAINSCOT [in *Joinery*] is the Timber Work that serves to line the Walls of a Room, being usually in Pannels, and painted to serve instead of Hangings.

Even in Halls, 'tis usual to have Wainscot Breast high, by Reason of the natural Humidity of Walls.

Some Joiners put Charcoal behind the Pannels of the *Wainscot*, to prevent the sweating of the Stone and Brick-walls from unglucing the Joints of the Pannels; others use Wool for the same Purpose; but neither the one nor the other is sufficient in some Houses: the only sure way is to prime over the Back-Sides of the Joints with *White-Lead*, *Spanish-Brown* and *Linseed-Oil*.

The Price of Wainscotting is various. The Wainscotting with *Norway Oak*, the Workmen finding Stuff, is valued at 6 s. or 7 s. per Yard Square: The Workmanship only is about 2 s. in *London*: in *Rutland* 3 s. 6 d. or 4 s. per Yard, and Mr. *Wing* says five, if the Mouldings be large.

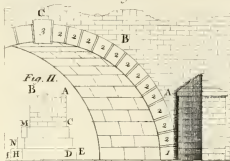
Plain Square Wainscotting. The Workman finding *Deal*, is valued at 3 s. and 3 s. 6 d. per Yard. For Workmanship only 1 s. per Yard.

Ordinary Bisection Wainscotting (the Workman finding *Deal*) is worth in *London* 3 s. 6 d. per Yard;



Fig. I.

Plate XXX



Yard: in the Country 4 s. and 4 s. 6 d. The Workmanship only 1 s. and 1 s. 6 d. per Yard.

Large Bisection *Wainscotting*, with *Dantzick* Stuff is valued at six or seven Shillings per Yard.

Of *Measuring Wainscotting*. Wainscot is generally measured by the Yard square, *i. e.* nine superficial Feet. Their Custom is to take the Dimensions with a String, pressing it into the Mouldings; for they say, (and it is reasonable to be believ'd) we ought to be paid for all where the Plane goes. Therefore when Joiners would take the Dimensions of a Room, they tack up a Line on the Top of the Corner of the Room, and as they carry it down to the Bottom, they press it with their Fingers into all the Mouldings; this they account the Breadth, and they measure the Circumference of the Room from the Length.

Some Joiners will measure this also with a String, but others do not.

The Dimensions being thus taken in the Feet, they multiply the Length by the Breadth, and the Product is the Content in Feet, which being divided by 9, the Quotient is the Content in Yards.

But you are to note, 1st, That Deductions are to be made for all Window-Lights, and that the Window-Boards, Cheeks and Soffets are to be measured by themselves.

2. That they reckon work and a half for *Window-shutters*, *Doors*, and such Things as are

wrought one both Sides; and indeed the Work is Half more.

3. That sometimes *Cornices*, *Bases* and *Sub-bases* are measured by the Foot lineal Measure; and so likewise are *Freezes*, *Architraves*, and *Chimney-pieces* measured, unless agreed for by the great.

WALLS [in *Architecture*, &c.] a Work of *Brick*, *Stone*, *Wood*, or the like, which make the principal Part of a Building, as serving both to enclose it, or separate particular Rooms, and to support the Roof, Floors, &c.

Walls are either intire or continual, or intermitted, and the Intermissions are either Pillars, or Pillasters.

Walls tho' built very thick and strong, and their Foundations laid deep, yet if carried on in a strait Line, are inclin'd to lean or fall; and such as are built crooked, tho' thin and weak, are much more lasting.

A *Wall* raised over a River on Arches of Pillars, will stand as firm as others whose Foundation is intire.

Hence it appears, that a Wall built much thinner than usual, by only having at every 20 Foot's Distance, an Angle, set out at about two Foot or more in Proportion to the Height of the Wall; or by having a Column at the like Distance erected along with it, six or eight Inches on each Side, and above the Thickness of the rest of the Wall: Such a Wall will be much stronger than if five Times the Quantity of Materials

rials were used in a great Wall.

Walls are distinguished into divers kinds from the Matter of which they consist. As,

Plastered or Mud-Walls, Brick-Walls, Stone-Walls, Flint or Boulder-Walls, and Boarded-Walls. In all which these general Rules are to be regarded.

1. That they be built exactly perpendicular to the Ground-work; for the right Angle therein depending, is the true Cause of all *Stability*, both in artificial and natural Position; a Man likewise standing firmest when he stands the most upright.

2. That the massiest and heaviest Materials be the lowest, as fitter to bear, than to be born.

3. That the Walls as they rise, diminish proportionably in Thickness, for Ease both of Weight and Expences.

4. That certain Burfes or Ledges, of more Strength than the rest, be interlaid like Bones, to strengthen the whole Fabric.

Plastered or Mud-Walls. These kind of Walls are common in Timber Buildings, especially ordinary Buildings; for sometimes the Walls are made of Brick between the Timber. But this Way is not approved of, because the Mortar corrodes and decays the Timber. These Mud-walls (as they are called in some Places) are thus made.

The Walls being quartered, and lath'd between the Tim-

ber (or sometimes lathed over all) are plaistered with Lime, which being almost dry, is plaistered over again with white Mortar.

This Sort of Work is commonly done by the Yard. For the Price of it, see *Pargetting* and *Plaistering*.

Brick-Walls, which are the most important and usual among us; therefore to the four Rules before mentioned, these are to be added.

1. Particular Care is to be taken about laying of the Bricks, *viz.* that in Summer they be laid as wet, and in Winter as dry as possible, to make them bind the better with the Mortar: That in Summer, as fast as they are laid they be covered up, to prevent the Mortar, &c. from drying too fast; that in Winter they be covered well to protect them from Rain, Snow and Frost, which are all Enemies to Mortar; that they be laid point and joint in the Walls as little as may be, but that good Bond be made there as well as on the Outside.

2. That the Angles be firmly bound, which are the Nerves of the whole Edifice, and therefore are commonly fortified by the *Italians*, even in their Brick Buildings, on each Side of the Corners, with well squared Stone, yielding both Strength and Grace.

3. In order to which, in working up the Walls of a Building it is not advisable to raise any Wall above eight Foot high, before the next adjoining Wall be wrought up to it, that so

good

good Bond may be made in the Progress of the Work: For it is an ill Custom among some Bricklayers, to carry or work up a whole Story of the Party Walls before they work up the Fronts, or other Work adjoining, that should be bonded, or wrought up together with them; which occasions Cracks and Settling in the Walls.

4. That if you build a House in the City of *London*, you make all your Walls of such Thicknesses as the Act of Parliament for re-building the said City enjoins; which Act you may see in the Article *House*; but in other Places you may use your Discretion. Yet for some Directions in this Matter, turn to the Article *House*.

5. It may be worth your Notice, that a Wall a Brick and half thick, with the Joint, will be in Thickness 14 Inches, or very near; whence 150 or 160 Bricks will lay a Yard square, measured upon the Face of the Building, and to the Square of 10 Foot (which is 100 Foot square Feet) are usually allowed 1700 or 1800 Bricks, and 4600 or 5000 Bricks will completely lay, erect or build, one Rod, Pole or Perch square; which Rod, Pole or Perch; (for by all these Names it is called) contains in Length (according to the Statute $16 \frac{1}{4}$ Feet, whose Square is $272 \frac{1}{4}$ Feet, superficial Measure, which is 30 Yards and $\frac{1}{4}$.

But tho' I have given the Number of Bricks for each of these Squares; yet these Numbers are not to be relied on as

absolutely exact; for no Exactness can be discovered as to this Particular, and that for several Reasons.

For notwithstanding that all the Bricks be made in the same Mould, and burnt in the same Kiln or Clamp; yet the Nature or Quality of the Earth of which they are made (which causes some to shrink more than others) and the Bricklayers Hand and Mortar, may cause a considerable Variation.

And besides these, some Bricks are warp'd in Burning, (which makes them that they will not lie so close in the Work) some are broken in the Carriage; so that 500 Bricks and the Tally or Tale is, for the most Part (if not look'd after) too little.

And besides all these Uncertainties, when Bricks are dear, and Lime cheap, the Workman by the great, will use more Mortar, and make the larger Joints, which is much worse for the Building.

6. It may be also noted, that (when all Materials are ready) a Workman with his Labourer, will lay, in one Day, 1000 Bricks, and some 12 or 1500.

7. All Brick Work, according to these Rules, is supposed to be one Brick and half thick, which is the Standard Thickness. If they are thicker or thinner, they must be reduced to that Thickness.

Of Measuring Brick Walls.

Bricklayers most commonly measure their Walls by the Rod square,

square, each Rod (which is by the Statute $16 \frac{1}{2}$ Foot;) so that a Square contains $272 \frac{1}{4}$ superficial Feet.

Therefore when they have taken the Dimensions (*viz.* the Length and Height) of the Wall in Feet, they multiply the Length by the Height, by cross Multiplication, and divide the Product by $272 \frac{1}{4}$, and the Quotient shews the Number of square Rods in the Superficies of that Wall.

But it being troublesome to divide by $272 \frac{1}{4}$, Workmen have a Custom to divide by 272 only, which gives the Contents something more than the Truth, which notwithstanding they take for it.

When they have then found the Area, or Contents of the whole Superficies of a Wall, they in the next Place consider its Thickness; for they have a certain Thickness to which they reduce all their Walls, and this Standard is *one Brick and a half thick*, as they phrase it, *i. e.* the Length of one Brick, and the Breadth of another; so that a Wall of three Bricks (Length) thick, of the same Height and Length with another of one and a half Brick thick, the former will contain twice as many square Rods as the latter.

Now to reduce any Wall to this Standard Thickness, take this Rule, which is plain and easy.

Say, as three is to the Thickness of the Wall in half Bricks, that is in the Breadth of the Bricks, the Breadth of a Brick

being always half its Length, so is the Area before found to the Area at their Standard Thickness of $1 \frac{1}{2}$ Brick.

Thus if a Wall be all of one Thickness from the Foundation to the Top, it is easily reduced to the Standard Thickness of $1 \frac{1}{2}$ Brick.

But if the Wall be of different Thicknesses (as they usually are in Brick Houses, being made thickest below, and thinner at every Story) then the best Way will be to measure every different Thickness by itself, and to reduce it to the Standard Thickness, and afterwards add all these several Areas into one Sum, out of which deduct the Doors and Windows (measured by themselves) and then the Remainder will be the true Area or Content of the whole Walling.

Note, That in some Places 'tis the Custom to measure by the Rod of 18 Feet long, and in others by the Rod of 16 Feet. In the former Case, the Area in Feet must be divided by 324, and in the latter by 356.

As to the Price.] The Price of building Walls is various in different Places, according to the various Prices of Materials.

Mr. *Leybourn* says, that the usual Price in *London* for building a Brick and a half Wall, the Workman finding all Materials, is 5 *l.* or 5 *l.* 10 *s.* per Rod square, and for the Workmanship only 30 *s.* per Rod square, which is about 1 *s.* per Yard square.

Mr. *Wing* says, That the usual Price in *Rutland*, (the Work-

Workman finding all Materials) is for a Brick and a half, 3 s. per Yard square, (which is but about 4 l. 10 s. per Rod) for a two Brick Wall 4 s. and for a two and a half Brick Wall 5 s. per Yard square.

And for the Workmanship only (of a Brick and a half Wall) 8 d. per Yard square, which is but about 20 s. per Rod, Statute Measure.

In *Suffex* a Rod of Brick and half Walls, Workmanship and Materials, will cost at least 8 l. For the Workmanship only, the usual Price is 24 or 25 s. per Rod square, in a Brick and half Wall.

Mr. *Leybourn* says, That in or about *London*, if the Bricks are laid in at the Builder's Charge, then 2 l. 10 s. per Rod, is the usual Price.

But he says likewise, for erecting new Structures, by taking down old Walls, it may be worth 3 l. or 3 l. 10 s. per Rod; because in taking down the Walls, there is much Time spent. And also more Mortar used in laying them again, than in the new Work.

Fence Walls are Walls built round Courts, Gardens and Orchards, &c. which are commonly called *Fence Walls*; of which some are made of Stone, some of Flints, or Boulders, and some of Brick.

1. *As to those made with Brick.*] These are commonly made (of Statute Bricks) a Brick and a half thick.

In some Parts of *Suffex* they are made of a Sort of great Bricks, which are 12 Inches

long, 6 Inches broad, and 3 Inches thick.

These Walls are but the Breadth of a Brick, or six Inches in Thickness, only at the Pilasters, where they are the Length of a Brick, or 12 Inches.

They usually set a Pilaster at every 10 Foot. Some of these Walls have stood well for 30 Years, and were in good Condition.

Of the measuring of them.] Fence Walls built of Statute Bricks, are commonly measured as the other.

But some measure them by the Rod in Length, and one Foot in Height, which they account a Rod in Measure; and in taking the Dimensions, they do it with a Line going over the Pilasters: this for the Length. So also for the Height, they measure that by the Line going over all the Mouldings (after the same Manner that Joiners measure their Work) even to the Top or Middle of the Copeing.

Some Workmen in making Fence Walls of Statute Bricks (if they can persuade their Masters to agree to it) measure all that is above a Brick and half thick (*viz.* the projecting of the Pilasters or Buttresses, and all below the Water-Table, by the solid Foot, which they afterwards reduce to Rods.

This Way is a considerable Advantage to the Workman, and a Loss to the Master-Builder; for it makes one sixth Part more of Measure than the Truth; because a Brick and half Wall is 14 Inches thick.

Fence Walls of great Bricks are generally measured by the Rod in Length, and a Foot in Height, which they account a Rod in Measure, the Dimensions being taken by a Line, as has been said above.

Of the Price.] Some Workmen in *Suffex* reckon for building Fence Walls (for Workmanship only) of Statute Bricks, a Brick and half thick, 1 s. 6 d. per Rod, at a Rod long, and a Foot high, taking their Dimensions by the Line, according as has been shewn.

Sometimes they build these Walls by the Square of 100 Foot at 8 s. per Square, which is but about 1 d. per superficial Foot.

For building Fence Walls with great Bricks, the common Price (for Workmanship only) is 1 s. per Rod, at one Rod long, and one Foot high, the Dimensions being taken by the Line, as above.

Of Copeing them.] Fence Walls, built with Statute Bricks, are sometimes cop'd with Stone, sometimes with Brick. If they are cop'd with Stone, the Copeing is left out of the Measure, and rated by itself; for the Price of which, see *Copeing*. If they are coped with Brick, it is measured into the rest of the Work.

And this Sort of Copeing is performed as follows. The Wall is carried up to the Top on one Side, and on the other Side there is two Courses of Bricks, standing on end, in an oblique reclining or slant Position, and a stretching Course

on the Top finishes the Wall.

But Fence Walls built of great Bricks are coped with copeing Bricks; of which, see *Bricks*. And this Copeing is also measured and rated with the rest of the Wall.

Of Stone Walls.

Stone Walls serve not only for Walls of Houses, &c. but also for Fence Walls round Gardens, &c.

Of measuring them.] These are in some Places measured by the Rod of 18 Foot Square; but in most Places they are measured by the superficial Foot.

There are three Things to be observed in measuring of them.

1. That if the Length of the Walls at the Ends of the Garden or House, be taken on the Outside of the Garden or House, then the Length of the Walls on the Sides of the Garden or House, ought to be taken on the Inside.

2. That when the Walls of a House are measured, the Doors and Windows are likewise to be measured and deducted from the whole.

3. That in measuring Fence Walls, they commonly measure the Height by a Line (pressed into all the Moulding) from the Top of the Copeing to the Bottom of the Foundation.

As to their Price.] Mr. *Wing* says, That Fence Walls of ordinary Buildings, are each (only the Workmanship) from

16 s. to 3 l. 10 s. *per* Rod, of 18 Feet square, which, he says, depends upon the Goodness of the Work.

He also says, that setting Fronts in great Buildings, *viz.* *Ashtar*, *Architrave*, *Windows* and *Doors*, with Ground-table *Fascias*, and other Members, is worth from 3 l. 10 s. to 5 l. *per* Rod, which, he says, depends upon the Height and well performing the Building.

But what he says, is not very intelligible; for 3 l. 10 s. *per* Rod, is but a little above 2 d. $\frac{1}{2}$ *per* Foot; and 5 l. *per* Rod, but little more than 3 d. $\frac{1}{2}$ *per* Foot; either of which is certainly too little for such ornamental Work, as setting off of Fronts in great Buildings. Neither does he mention any Thing of the Thickness of the Walls.

And then as for Fence-walls, or Walls in ordinary Buildings, it does not appear how the Goodness or Badness of such plain Work, can vary the Price from 16 s. to 3 l. 10 s. *per* Rod.

Mr. *Hatton* talks much after the same Manner, when he says, that one Foot of plain Work (as Walls, &c.) is worth about 8 d. working and setting. Nor does he mention any Thing of the thickness.

But these Authors having left us in the dark, I shall leave them, and inform you what is more intelligible, and what a *Suffex* experienc'd Workman says of the Matter: That for Building a 12 Inch Wall they have 2 d. *per* Foot; for an 18 Inch Wall, 3 d. that

for a Wall of two Foot thick, they have 4 d. *per* Foot.

These Prices are to be understood of Walls which have two fair Sides; for if they have but one fair Side (the other standing against a Bank) they have a less Price. And in this Case some Workmen have built a Wall for 2 d. $\frac{1}{2}$ *per* Foot.

Flint or Boulder Walls.

These Walls are much used in some Parts of *Suffex* and *Kent*, both for Fence Walls, round Courts, Gardens, &c. but also Walls of Stables and other Out-houses, which have looked very handsome.

To build Walls and greater Works of Flint, of which we do not want Examples in our Island, and particularly in the Province of *Kent*, (says Sir *Henry Wotton*) is, I conceive, says he, a Thing utterly unknown to the *Ancients*, who, observing in that Material a kind of metallick Nature, or at least a Fusibility, seem to have resolved it into a nobler Use; an Art now utterly lost, or perchance kept up but by a few Chymists.

Some Workmen say, that for building Flint or Boulder Walls, they use to have 12 s. *per* hundred (for so they phrase it) by which they mean 100 superficial Feet.

A Right and Left-hand Man fit well together for this Work, for they have a Hod of Mortar pour'd down upon the Work, which they part between them, each spreading it towards him-

f- If, and so they lay in their Flints.

Their Mortar for this Work must be very stiff, and it is best to have a good Length of Work before them ; because they work but one Course in Height at a Time ; for if they should do more, it would be apt to swell out at the Sides, and run down.

They also say it is very difficult to make the Work stand in misty Weather.

Bearded Walls.

Walls are sometimes boarded, particularly the Walls of some Barns, Stables and other Out-houses. But of this Kind of Work, see *Weather-Boarding*.

WALLS [for Gardens, &c.] The Position, Matter and Form of *Walls* for Fruit-trees, have great Influence on them for ripening the Fruit ; tho' Authors differ as to the Matter and Form of them, which ought to have the Preference.

The Reverend Mr. *Laurence* directs, that the Walls of a Garden be not built directly to face the four Cardinal Points ; but rather between them, *viz.* South-east, South-west, North-east and North-west ; in which the two former will be good enough for the best Fruit, and the two latter for Plumbs, Cherries, and baking Pears.

Mr. *Langford*, and some others propose, that Garden Walls should consist chiefly of Semi-circles, each about six or eight Yards in Front, and including

two Trees ; and between every two Semi-circles, a Space of two Foot of *Plain-wall*.

By such a Position, he says, every Part of a Wall will enjoy a Share of the Sun one Time with another ; besides, that the Warmth will be increas'd, by the collecting and reflecting of the Rays in the Semi-circles, and the Trees within will be also screened from injurious Winds.

Mr. *Fatio* proposes to have *Garden-walls* built sloping, instead of perpendicular, or reclining from the Sun ; that what is planted against them may lie more exposed to his perpendicular Rays ; which must very much contribute to the ripening of Fruit in our cold Climate.

He directs, That the Angle of Reclination be that of the Latitude of the Place ; that when the Sun is in the Meridian at the Equinoxes, his Rays may strike perpendicularly ; yet others prefer *perpendicular Walls*, and even inclining ones, or such as hang forwards to the Sun ; because such will receive the Sun's Rays, perpendicularly, when she is low, as in *Spring* and *Autumn*, or in the Evening and Morning ; which they imagine to be more serviceable than the greatest Heats of the Sun at *Mid-summer* upon *Reclining Walls*.

To this may be added, that in *Autumn* the Sun is most wanted to ripen *Winter* Pears, in order to which they should be kept dry, which cannot be done

done against sloping Walls; the Dews, &c. lying much longer on them, than on such as are perpendicular.

However Mr. *Fatio's* sloping Walls have one great Advantage, *viz.* that Fruit-trees, as Vines, &c. being planted against them, close Glasses may be set on the Fruit, which will very much forward its Ripening.

As for the Materials of Walls for Fruit-trees, Mr. *Switzer* approves of Brick as the best, as being the warmest and kindest for the ripening of Fruits, &c. affording the best Conveniency for uniting,

But Mr. *Laurence* affirms on his own Experience, that Mud Walls, made of Earth and Straw, tempered together, are better for the Ripening of Fruit, than either *Brick* or *Stone-Wall*: and he adds, that a Copeing of Straw laid on such Walls, is a great Advantage to the Fruit, in sheltering them from perpendicular Rains, &c.

WALLING. Bricklayers commonly measure their Work by the Rod square, 16 Feet and a half; so that one Rod in Length, and one in Breadth, contain 272.25 square Feet; for 16.5 multiplied in it self, produce 272.25 square Feet.

But it is the Custom in some Places to allow 18 Feet to the Rod; which is 324 square Feet.

In some Places again, the Custom is to measure by the Rod of 21 Feet long, and three Feet high; which makes 63 square Feet; and in this Case they never regard the Thickness of the Wall; but the Custom is to make the Price according to the Thickness.

When you are to measure a Piece of Brick-work, you must first consider which of the foregoing ways it is to be done by, and then multiply the Length and Breadth in Feet together, and divide the Product by the proper Divisor, either for Rods or Roods, and the Quotient will be square Rods, or square Roods accordingly.

But usually Brick Walls which are measured by the Rod, are to be reduced to a Standard Thickness, *viz.* of a Brick and a half thick (if there has been no Agreement made on the contrary. And to reduce a Wall to a Standard Thickness, the following is

The RULE.

Multiply the Number of superficial Feet contained in the Wall, by the Number of half Bricks that Wall is in Thickness; and one Third of the Product will be the Contents in Feet, reduced to the Standard Thickness of a Brick and a half.

Example

Example 1. Suppose a Wall to be 72 Feet 6 Inches long, and 19 Feet 3 Inches high, and 5 Bricks and a half thick, how many Rods of Brick Work are contained in that Wall when reduced to the Standard ?

$$\begin{array}{r}
 19.25 \\
 72.5 \\
 \hline
 9625 \\
 3850 \\
 13475 \\
 \hline
 1395.625 \\
 11 \\
 \hline
 3)15351.875 \\
 \hline
 272.25) 5117.291 (18 \text{ Rods,} \\
 \hline
 239479 \\
 \hline
 68.06) 21679 (3 \text{ Quarters of a Rod.} \\
 12.61 \\
 \hline
 \end{array}$$

Answer, 18 Rods 3 Quarters 12 Feet.

$$\begin{array}{r}
 F. \quad I. \\
 72 \quad 6 \\
 19 \quad 3 \\
 \hline
 648 \\
 72 \\
 18 : 1 : 6 \\
 9 : 6 : 0 \\
 \hline
 1395 : 7 : 6 \\
 11 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 3) 15345 \\
 \hline
 272) 5115 (18 \text{ Rods.} \\
 2395 \\
 \hline
 68.) 219 (3 \text{ Quarters of a Rod.} \\
 15
 \end{array}$$

Note,

Note, That that 68.06 is one fourth Part of 272.25. so the Answer by that second Way is 18 Rods, 3 quarters, and 15 Feet, more by about 2 Feet and a half, than by the first Way, in which it is done decimally; but this Surplus is very insignificant.

Note also, That in reducing of Feet into Rods, they usually reject the odd Parts, and divide only by 72, as is done in the second Way of the last Example;

Example 2. If a Wall be 245 Feet 9 Inches long, and 16 Feet 6 Inches high; How many Rods of Brick Work are contained in it, when reduced to a Standard Thickness?

$$\begin{array}{r}
 245.75 \\
 16.5 \\
 \hline
 122875 \\
 147450 \\
 24575 \\
 \hline
 4054.875 \\
 5 \\
 \hline
 3) 20270 \\
 272) 6756 \text{ (24 Rods.} \\
 \hline
 1316 \\
 \hline
 24 \text{ (3 Quarters of a Rod.}
 \end{array}$$

Answer, 24 Rods, 3 Quarters, 24 Feet.

F.	I.			
245	9			
16	6			
<hr/>				
1470				
245				
122	:	10	:	6
12	:	00	:	0
<hr/>				
4054	:	10	:	0

The Ans. in Feet.

I shall in the next Place shew how to find proper Divisors to facilitate the Operation, because it would be too intricate and tedious to perform by Scale and Compasses.

To find proper Divisors.

Divide 3, (the Number of half Bricks in $1\frac{1}{2}$) by the Number of half Bricks in the Thickness, the Quotient will be a Divisor, which will give the Answer in Feet.

But if you would have a Divisor, to give the Answer in Rods at once, then multiply 272.25 by the Divisor found for Feet, and the Product will be a Divisor, which will give the Answer in Rods.

Example, To find a proper

Divisor to reduce a Wall of 3 Bricks thick.

Divide 3 by 6 (the half Bricks in the Thickness) and the Quotient will be .5, which is a Divisor that will give you the Answer in Feet.

Then multiply 272.25 by .5 and the Product will be 136.125, which is the Divisor that will give the Answer in Rods; that is as 136.125 is to the Length of the Wall, so is the Height to the Content in Rods; or as .5 is to the Length, so is the Height to the Content in Feet.

After the same Manner you may find Divisors for any other Thickness, which you will find to be, as express'd in the following Table.

The Thickness of the Wall.	Divisors for the Answer in Feet.	Divisors for bringing the Answer in Rods.
1 Brick thick	1.5	408.375
$1\frac{1}{2}$ Brick thick	1	272.25
2 Bricks thick	.75	204.1875
$2\frac{1}{2}$ Bricks thick	.6	163.35
3 Bricks thick	.5	136.125
$3\frac{1}{2}$ Bricks thick	.4285	116.678
4 Bricks thick	.375	102.0937

Let the second Example preceeding (where the Length is 245.75, the Height 16.5, and the Thickness $2\frac{1}{2}$ Bricks) be wrought by Scale and Compasses. Thus,

Extend the Compasses from

163.35 (the Tabular Number against $2\frac{1}{2}$ Bricks) to 245.75, and that Extent will reach from 75.5 to 12.13; that is 12 Rods and a little above half a Quarter.

Again,

Again, if the Length be 75 Feet 6 Inches, and the Height 18 Feet 9 Inches, at $3\frac{1}{2}$ Bricks thick, how many Rods are contained therein?

Extend the Compasses from 116.678 (the Tabular Number) to 18.75, that Extent will reach from 75.5, to 12.13; that is 12 Rod, and a little above half a Quarter.

It will be very proper and convenient, for such as frequently measure Brick Work, to have in the Line of Numbers, little Brass Centre Pins, at each of the Numbers in the third Column of the foregoing Table, with a Figure to denote the Thickness of the Wall.

If a Wall be 104 Feet 9 Inches long, and 17 Feet 3 Inches high; How many Rods does it contain?

$$\begin{array}{r}
 104.75 \\
 17.25 \\
 \hline
 52375 \\
 20950 \\
 73325 \\
 10475 \\
 \hline
 63 \overline{) 1806.9375} \quad (28 \\
 \underline{126} \\
 546 \\
 \underline{504} \\
 42
 \end{array}$$

Answer, 28 Rods, 42 Feet.

F.	I.			
104	9			
17	3			
<hr/>				
728				
104				
26	:	02	:	3
12	:	09	:	0
<hr/>				
1806	:	11	:	3

Note, That those who dig Cellars, do many Times do them by the Floor, 16 Feet Square, and a Foot deep being a Floor of Earth; that is 324 solid Feet.

WASHING [in *Painting*] is when a Design drawn with a Pen or Crayon, has some one Colour laid over it with a Pencil, as *Indian Ink*, Bistre or the like, to make it appear the more natural, by adding the Shadow of Prominences, Apertures, &c. and by imitating the particular Matters, whereof the Thing is suppos'd to consist.

Thus they wash with a pale Red to imitate Brick and Tile; with a pale *Indian Blue*, to imitate Water and Slate; with Green, for Trees and Meadows; with Saffron or *French Berries*, for Gold or Bricks; and with several Colours for Marbles.

These Washes are usually given in equal Tints or Degrees throughout; which are afterwards brought down and softened over the Lights with fair Water, and strengthened with deeper Colours for the Shadows.

WASHING of Colours. Some Colours are of such a gritty, sandy Nature, that it is impossible to grind them so fine as some curious Works require; therefore in order to get forth the Flower and Fineness of the Colour, you must do thus;

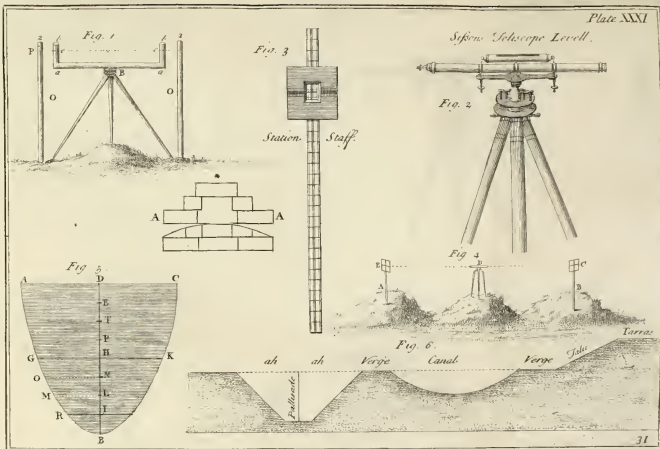
Take what Quantity of Colour you please to wash, and put it into a Vessel of fair Water, stir it about till the Water be all colour'd therewith, and

if any Filth swim on the Top of the Water, scum it clean off, and when you think the grossest of the Colour is settled at the Bottom, then pour off that Water into another earthen Vessel, that is large enough to contain the first Vessel full of Water four or five Times; then pour more Water into the first Vessel, and stir the Colour that remains till the Water be thick; and after it is a little settled, pour that Water also into the second Vessel, and fill the first Vessel again with Water, stirring it as before; do this so often, as till you find all the finest of the Colour drawn forth, and that none but coarse gritty Stuff remains in the Bottom; then let this Water in the second Vessel stand to settle till it is perfectly clear, and that all the Colour be sunk to the Bottom; which when you perceive, then pour the Water clear from it, and reserve the Colour in the Bottom for Use, which must be perfectly dry'd before you mix it with Oil to work.

The Colours thus ordered, are *Red Lead*, *Blue* and *Green Bice*, *Verditer*, *Blue* and *Green Smalt*, and many times *Spanish Brown*, when you would cleanse it well from Stones for some fine Work, as also *Yellow Oker*, when you intend to make *Gold Size* of it.

WATER Colours [in *Painting*] are such Colours as are only diluted and mix'd up with Gum Water, in Contradistinction to *Oil Colours*.

Water Colours are us'd in what



what we call *Limning*; as *Oil Colours* are in Painting, properly so call'd.

WATER TABLE [in *Architecture*] is a Sort of Lodge left in Stone or Brick Walls, about 18 or 20 Inches from the Ground (more or less) from which Place the Thickness of the Wall is abated (or taken in) the Thickness of a Brick.

In Brick Walls two Inches and a $\frac{1}{4}$; thereby leaving that Ledge or Jutty that is call'd a Water Table.

These *Water Tables* are sometimes left plain, and sometimes they are wrought with Mouldings; if the latter (besides the plain Measure of the Wall) they are rated at so much *per Foot*, running Measure.

WATER COURSES. These are commonly rated by the Foot running Measure. If the Workman find Materials, about 10 *d. per Foot*; if he find no Materials, about 8 *d.*

As to the Conveyance of Water from the Tops of Houses and Balconies,

It is enacted by an Act of Parliament made in the XI. Year of King *George I.* that the Water falling from the Tops of Houses, after the 24th of *June 1725* within the Cities of *London* and *Westminster*, or their Liberties, from their Balconies, Pent-Houses, &c. shall be convey'd into the Channels by Party Pipes, fix'd on the Sides or Fronts of the said Houses; on the Forfeiture of ten Pounds for every Offence.

WATER being an Element so absolutely necessary to all Manner of Habitations, and being not always to be found near enough to them for Use; it will not be improper to consider by what Means it may be found, and how it may be conducted.

The learned **VARENNIUS** in his System of *General Geography*, tells us from *Vitruvius*, that if Fountains do not flow of their own Accord, their Heads are to be sought for under Ground, and so collected together. Which Springs may be discovered in the following Manner: If you lie down on the Ground, in Places where you would seek for them, before the Sun rises, and having plac'd your Chin as close as you can, till it is, as it were, prop'd by the Earth, so that the adjacent Country may be plainly seen; (the Reason of this Posture is, that by this Position the Sight will not wander any higher than it ought): if you keep your Chin unmov'd, it will give a certain Definition and true Level of the Parts where you are plac'd, and in those Places where you see Vapours gathering themselves together and rising up into the Air, there you may dig; for this Sign never happens in a dry Place.

2. *Coronarius* and some of the Ancients, intimate, that wherever the Twig-withy, Fleabane, Reeds, Trefoil, Pond-Grass and the Bull-Rush grow very plentifully, there you may
most

most probably find Water ; and he directs to find it by the following Experiment.

By digging a Ditch three Foot deep, and having a leaden Vessel or Earthen Pot, made in the Form of a Semi-Circle, rub it over with Oil at Sun-set ; then having a Piece of Wood half a Foot long, well wash'd and afterwards dry'd, tie this on a small Stone on the middle of it, and fix it on the middle of the Pot or Vessel with Wax : Having done this, turn the Mouth of the Pot downwards, in the Trench that has been dug, taking Care that the Wool hang down in the middle of the Vessel ; then cover the Vessel with Earth, to the thickness of a Foot, and leave it till the next Morning ; and if at Sun rising you uncover it, and perceive small dewy Drops hanging on the Bottom, and the Wool wet, there is Water in the Place.

If the Wool be very full of Water, and the Drops hanging on the Pot be very large, you may thence conclude you are not very far from the Spring ; but if it be only moist, tho' there be a Spring in that Place, yet you may conclude that it lies very low, and not to be come at, without great Pains and Charge : But if you do not find these Symptoms, you must make the Experiment in another Place.

Water may also be discover'd by the Nature of the Soil. If it be a black fat Soil, and abound with Pebbles of a black or yellowish Colour, you need

not fear wanting Water in such a Place.

Again : If the Soil be glutinous or clayey, you may expect to find Water in it.

Again, Water or Springs may be discovered by the natural Produce of the Soil (as before) as where Water-Plantane, the Sun-Flower, Reed-Grass, Ox-bane, Brambles or Shave-Grass, Calamint, Mat-Rushes, Maiden-Hair, Melilot, Sower-Sorrel or Ditch-Dock, Cinquefoil, Blood-wort, Night-Shade, Water Milfoil, or Coltsfoot grow, there you will find Springs, and where they grow in most Abundance, there you will find the most plentiful Springs.

Some make use of the following Experiment for finding Water. They dig a Ditch a Foot broad and 3 Feet deep, and about the middle of the Day, hang a dry Spunge in the middle of it for 3 Hours, covering it close with large Reeds ; and if the Spunge, when it is taken from thence, is wet, they take it for an assured Sign that there is Water there, and proceed to dig ; but if on the contrary the Spunge is dry, they conclude it is in vain to search for it there.

Coronarius informs us from *Democritus*, that the Discoverers of Water aver, that flat and extensive Plains are commonly most destitute of Water ; whereas rising Grounds seldom fail of abounding with it ; and that those Eminences, which are most shaded with Trees, have generally the greatest Share of it.

Others

Others of the Antients say, that wherever you can discover Swarms of Flies, hovering and pitching about one and the same Place, they are certain Signs that Water is there.

Most of these Observations of the Antients are agreeable to those of modern Practitioners.

The several Kinds of Weeds, before mentioned, are certain Indications, that Water (if it does not break out) is near at Hand. And to this it may be added, that those kind of Herbs grow on moorish black Land, on the Sides of Hills, and where the Ground is mixt with Pebbly Gravel or Rock, that is of a dusky brown sandy Colour.

But there is not a more certain Sign of Water in the World, than where Alder-Wood grows naturally and of its own Accord: and even the Oak it self is found to grow on moist Hills.

After this short Account of the Methods of discovering of Springs, their Situation, &c. I shall next proceed to the Operation it self.

Those who have been conversant in Mines and Coal-works, observe that there are two Sorts of Springs; those that lie near the Surface, and are suppos'd to proceed intirely from Rain; and those that lie deeper and proceed from a more remote Cause.

It would then be dangerous to dig deeper than the Surface where they first appear, lest they should take a wrong Current, and instead of breaking out Side-ways, should sink be-

neath their Cause, and be lost in the Crannies and Openings of such Rocks of Stone and Gravel as lie contiguous thereto; but those are either stronger or weaker, according as they happen to lodge or fall on Earths, which are in their Nature more or less glutinous and clayey, and consequently tenacious of Water; or are otherwise of a more arenaceous, gravelly, sandy, or of a drying Chalk and whitish Earth; or which is very common, of a stinty or hollow Substance. These uppermost Springs must therefore be sought after with Caution; but as to such as lie lower, there is no Fear of Injury.

As to the Quality of WATER.

Those who seek for Water, should first consider what the Places are in which Water is to be found.

In the following Places Springs are certain and good: In Chalk, some say, it is fine, but rises not very high; this is reckon'd the best Water of all.

In sandy Gravel also it is fine; but if it is found in low Places (these are generally Rain Springs) and then it will be muddy and unfavoury; but in black Soils, there are fine thin Distillations found, which are collected as they subside from Winter Rains in clayey Grounds, and those have the best of Tastes.

In Ground which is a clear Gravel, Springs abound but little,

little, and the Veins are not certain; but those are extraordinary sweet.

In large, pebbly Gravel, and in Sand, Stone or loose Veins of Coal, they are more stable and certain, and these have all a good Taste.

They are plenty also in Red Stone, and good, if they don't slip away, and run off through the Interventions thereof.

They flow plentifully also under the Foot of Mountains, and in Stony Places: these are very cold, but very healthy; but the Water that is found in Champion open Places (such as the Water is in all stagnated Ponds) is thick, betwixt hot and cold, and not sweet, except it be that which springs out of the Bottom of Mountains, and runs into the middle of large Plains: and where they are shaded with Trees, there they excell the Sweetness of Mountain Springs.

The Manner of discovering Springs having been before treated of, the next Thing to be considered, is the taking the exact Levels, and making proper Allowances for the Curvature of the Earth, and adjusting the Fall or Current, which is generally allow'd for the Descent of Water.

For taking of Levels, especially those that run any Distance, the following Instruments are in the most Esteem.

Of these Instruments or Levels there are various Sorts; of which I shall take Notice of but two or three.

Of all the *Levels* which

have been produc'd, there is none for Portableness, Cheapness, Certainty and Dispatch, exceeds that which follows; it being what may be made or purchas'd for 8 or 10 s. whereas several other *Levels* will cost five or six Pounds.

This *Level* is a Tube made of Brass or other-like solid Matter, about three Foot long, and 12 or 15 Lines Diameter, whose Ends are turn'd up at Right Angles, for receiving two Glass Tubes, three or four Inches long, fastened on them with Wax or Mastic; at the middle and underneath this Tube, is fix'd a Ferril, for placing it upon its Foot: This *Level*, tho' it be a very simple one, is very commodious for levelling small Distances, says M. *Le Bion*.

An Instrument founded upon the same Reasons, tho' not made exactly in the same Manner, is describ'd as follows: It consists of a Piece of Heart of Oak, of two Inches square, in the middle of which was a large Groove, into which was fix'd a Tin Tube, of about two and a half or three Foot long; being the Length of the Piece of Wood turn'd up at the End, into which at *aa* were put in two Tubes of Glass, of an equal Length, reaching to *bb*; now into either Ends of the Glass Tubes, which are always open, you may pour in Water so high, till it reaches the prick'd Line *cc*, or thereabouts.

This Instrument may be fix'd on a Tripod, or a plain Table, or any other Instrument for Surveying.

veying, is slipp'd into it at B; and if it be manag'd with any Kind of Dexterity or Discretion, it will immediately form a *Level*, as *c c*, before mentioned, which tho' it be farther off or nearer to *a a*, is not material; the Water which is in the Tube naturally resting on the Level, over which you are to take your View. See *Plate, Fig. 1.*

But if you have a Mind to enlarge your View a great way, you may frame in a little Post on one Side of your Level at O, which shall have a Screw fix'd into it at P, and may be either rais'd higher or lower at Pleasure, as your Water is in the Tubes, through which you may have Sight to look at N^o 2, 2, as you do thro' other Levels.

The Rationale of this and all Levels of this Kind, are, that Water naturally places it self level; and therefore the Height of the Water in the Glass Tubes, will be always the same in Respect to the Centre of the Earth.

The next I shall mention is the *Telescope Spirit Level*, a genteel and ingenious Instrument, accounted the Invention of Mr. *William Sisson*, being of great Use for those who are to take the Dependance of a River (or any other Length) for 15 or 16 Miles or more.

This Instrument consists of a brass Telescope, of a convenient Length, the longer the better, provided the Parts of the Instrument which support it, be proportionably strong.

Within this Telescope is fix'd a Hair, and a small Micrometer, whereby the Distances may be determined at one Station, near enough for the Business of levelling; upon this Telescope is fix'd with two small Screws, the *Spirit Tube* and *Bubble* therein, which *Bubble* will rest exactly in the middle of the Tube, when the Telescope is set truly level.

Under the Telescope is a double Spring, with two Screws, by which the Bubble is brought exactly to a Mark in the middle of the Tube; to which Spring is fix'd a conical Ferril, which is a Direction for the Telescope to move horizontally at Pleasure.

There is also a three-legg'd Staff, a Ball, Socket, and four Screws, to adjust the horizontal Motion, the same with that belonging to all Surveying Instruments. See *Plate, Fig. 2.*

For your Assistance to this, and the other Levels before-mention'd, you must be provided with two Station Staves, represented, *Fig. 3.* each ten Foot long, that may slide one by the Side of the other to five Foot, for the easier Carriage; these must be divided into 1000 equal Parts, and numbered at every tenth Division 10, 20, 30, 40, &c. till you come to 1000; but every centesimal Divisions (which is the most that can be express'd in the Figure before-mentioned) as 100, 200, 300, &c. to 1000, ought to be express'd in large Figures, that the Division may be more easily counted; and

you may also have another Piece, five Foot long, divided also into 500 equal Parts, to be added to the former, when you shall see Occasion.

Upon these Staves are two Vanes or black Boards made to slide up and down, which will also stand against any Division on the Staff, by the Help of Springs; these Vanes are best made 30 Parts wide, and 90 Parts long; let the Faces of them be divided into three equal Spaces; by two Lines drawn Length ways; let the two extreme Parts be painted white, and the other two black, which will render them fit for all Distances. See *Plate, Fig. 3.*

When you are thus provided with a good Instrument, two Station Staves, a Chain and two Assistants, you may proceed to your Work; but first it will be necessary to know if your Instrument be well adjusted.

Now to do this, you are to chuse some Field or Meadow, which is nearly level, and set down the Instrument about the middle thereof, and make a Hole in the Ground under the Centre of the Instrument, from which measure out a Right-Line, some convenient Length as 20 Chains, and there leave one of your Assistants with his Station Staff; and then return to the Instrument, and measure out the same Number of Chains, *viz.* 20 the other way: by the Direction of the Instrument and last Station Staff, as near in a Right-Line as you can guess, and there leave your other As-

sistant with his Station Staff, so will the Instrument and Station Staves be in a direct Line.

Then return to the Instrument, and set it horizontal, which is presently done by Ball and Socket, and turn the Telescope about on its horizontal Motion to your first Assistant, and move the Telescope by the two Screws in the double Spring, till the Bubble rests exactly in the middle of the Spirit Tube; then observe where the Hair cuts the Staff, and direct your Assistant to move or slip the Vane or Board up and down, till the Hair cuts the middle thereof, so that you can see as much of the Vane above the Hair, as is below it, and there give him a Sign to fix it; then direct the Telescope towards your second Assistant, and proceed in the same Manner; so are the Vanes on each Staff, equi-distant from the Centre of the Earth.

Remove the Instrument to that Assistant which is nearest the Sun, that you may have the Advantage of the other Assistant's Vane, and there set down the Instrument, as near the Staff as you can; then having set the Instrument horizontal, so that the Bubble rests in the middle of the Tube, observe what Direction is then cut by the Hair in the Telescope, above or below the middle of the flat Board or Vane; for so many Divisions must the other Assistant's Vane be elevated or depress'd, which you must direct him to do accordingly.

Here the Distance of the Instrument

Instrument from the Station Staff is 40 Chains, for which you must make an Allowance for the Earth's Curvature, which, by the following Table you will find to be $16 \frac{1}{10}$ Parts; therefore let the Vane on the Staff be raised $16 \frac{1}{10}$ Parts.

Then direct the Telescope to the Vane thus raised, and if the Hair cuts the Middle thereof, while the Bubble rests in the Middle of the Tube, the Instrument is right, but if not, raise or depress the Telescope by the Screws in the double Spring, till the Hair cuts the Middle of the Vane, and then by the Help of the Screws that fixed the Tube to the Telescope, move the Bubble, till it rests in the Middle of the Tube, so is the Level adjusted.

As to the Allowances to be made for the Curvature of the Earth, when the Station Staves are planted at unequal Distances from the Instrument, you must take the following Method.

Suppose the Instrument was placed on an Eminence between two Valleys A and B, and the first Assistant standing with his Station at C, and the second at D, and it is required to know the different Height of the Hills C and D.

First, Set the Instrument horizontal, and then direct the Telescope to the first Assistant's

Staff at C, and by the Spring Screws, set the Bubble exact, observing where the Hair cuts the Staff, and by Signs cause him to move the Vane higher or lower, till the Hair cuts the Middle thereof, and then give him a Sign to note down the Division, cut by the upper Edge of the Vane, which suppose 104 Parts from the Ground, and by the Micrometer in the Telescope, find the Distance from the Instrument to the Staff C, to be about 10 Chains,

Then direct the Telescope to D, and proceed in the same Manner as before, and find that the Hair cuts 849 Parts from the Ground, and by the Micrometer, the Distance to D, is determined to be about 35 Chains.

Next look into the Table of Curvature following, and find against 10 Chains, one Part to be deducted for the Curvature of the Earth at that Distance, so will the Assistants Note be made 103 Parts.

Also against 35 Chains you will find $\frac{7}{1210}$ which being deducted out of 489, there remains $836 \frac{3}{10}$, which must be noted by the second Assistant.

Now if the 103, as noted by the first Assistant, be subtracted from $836 \frac{3}{10}$, as noted by the second, the Remainder will be $733 \frac{3}{10}$, and so much the Hill c is higher than the Hill d.

A TABLE of the Earth's Curvature, calculated to the Thousandth Part of a Foot, at the End of every Chain, from one Chain to 40.

Chains.	Dec. Feet.	Chains.	Dec. Feet.	Chains.	Dec. Feet.	Chains.	Dec. Feet.
1	000	11	013	21	045	31	099
2	000	12	015	22	050	32	106
3	001	13	017	23	055	33	113
4	002	14	020	24	060	34	120
5	003	15	023	25	065	35	127
6	004	16	026	26	070	36	134
7	005	17	030	27	075	37	141
8	007	18	033	28	081	38	149
9	008	19	037	29	087	39	157
10	010	20	041	30	093	40	166

Thus you have a Table of the Curvature of the Earth; but, if you have not the Table at hand, or the Number required be not to be found therein, then you may find the Allowance which is to be made at any Distance by the following Rule.

Multiply the Square of the Chains by 31, and divide the Product by 300000, and you will have the Answer.

In this Manner, by making an Allowance for the Curvature of the Earth, you may send a Station Staff forwards half a Mile or farther, from the Instrument, and take a Sight over Valleys at once; the horizontal Distance being in this Case the only Thing to be regarded.

I shall now come to the Ope-

ration, by which it may be known, whether Water may be conveyed in Pipes or Trenches, from a Spring-head, to any determined Place.

At the Spring-head, set up one of your two Station Staves, as nearly perpendicular as you can, and leave with one of your Assistants, proper Directions for raising or depressing the Vane on his Staff, according to certain Signs, which you, standing at your Instrument, shall give him. Also let him be provided with Pen, Ink and Paper, to note down very carefully the Division of the Staff which the Vane shall cut, when you make a Sign that it stands in its right Position.

Carry your Instrument towards the determined Place you are

are going to, as far as you can see them; so that thro' the Telescope you may but see any Part of the Staff left behind, when the Instrument is set horizontal; and from that Place send your Assistant forward with his Station Staff, with the same Instructions which you gave at first.

Set the Instrument, by the Help of the Ball, Socket, and Screws, and direct the Telescope to your first Assistant's Staff, and then by the Help of the Spring-Screws, bring the Bubble exactly to the Middle of the Tube, and when it rests there, give a Sign for your Assistant to note the Parts of the Staff.

Turn about the Telescope to your second Assistant's Staff, and by the Spring Screws as before, set the Bubble exact; then direct your second Assistant to move the Vane higher or lower, till you see the Hair in the Telescope cuts the middle of the Vane or Sight-board; (but in long Distances the Hair will almost cover the Vane; however let it be set in such a Manner, that as much may be above the Hair as below it, (as near as you can guess) and then give him a Sign to note the Division upon the Staff; and always let your Assistants note the Division cut by the upper Edge of the Vane.

Let your first Assistant then bring his Station Staff from the Spring Head, and changing Places with the second Assistant, let your second Assistant carry his forwards to the deter-

mined Place, to which you are going, and at a convenient Distance erect it perpendicular, whilst your first Assistant carries with his Staff, where your second Assistant stood before.

Place your Instrument between your two Assistants, as near the middle as you can, on account of the Curvature of the Earth, and first direct your Telescope to your first Assistant's Staff, and when the Telescope is levelled to one of the Divisions on the Staff, let him note that Division in an orderly Manner, under the first Observation; and let the second Assistant do the same.

And in this Manner proceed over Hill and Dale, as strait forwards as the Way will permit, to the appointed Place (only repeating these Directions) tho' it be 20 Miles distant from the Spring Head.

But in the whole Passage, let this be a constant Rule, from which you must never depart, *viz.* that your first Assistant must at every Station stand between the Spring Head and your Instrument, and your second Assistant, must always stand between the Instrument and the appointed Place to which the Water is to be conveyed; and also the first Assistant must be sure to place his Staff exactly in the Place where the second stood.

Being come to the Place appointed, let both your Assistants give in their Notes, which ought to stand in the Manner and Form following.

<i>First Assistant's Notes.</i>		<i>Second Assistant's Notes.</i>	
Stations.	Parts.	Stations.	Parts.
1	1029	1	1325
2	529	2	634
3	695	3	743
4	793	4	898
5	821	5	762
6	1378	6	1354
7	724	7	891
8	227	8	1449
9	465	9	532
10	732	10	891
11	321	11	654
12	621	12	1531
Sum	8335	Sum	11364

When you have taken the Levels, and summ'd up the same, you will find the Difference of the two Assistant's Notes to be 3029 Parts, which is about 3 Foot $\frac{1}{3}$. But that you may be the more certain, it is best to try the same in another Tract, and by another good Instrument, and it may happen to be the same, which it will be very near, if the same has been rightly survey'd.

Where note, that if in the making the second Experiment, tho' you take more Stations than at the first, yet the Notes compar'd together will be, if not equal, yet will differ but very little in the Parts.

Note, If from the first Assistant's Staff you measure any Number of Chains towards the Place you are going to, as

suppose 20, and then set down the Instrument, and then measure ten Chains forwarder, and there place the other Station Staff, you will have no Occasion to make any Allowance for the Curvature of the Earth, because the Instrument being planted in the Middle of the Distances between the Station-Staffs, the Errors mutually destroy one another.

But this measuring the Distances, with the Chain or otherwise, is very tedious, and in some Places (where the Ground is very uneven) unpracticable, unless you make a Multitude of Stations; so if the Way between the two determined Places, whose different Heights you would know, lies over Hills and Dales, then you must in that Case make four or five

five Stations, otherwise you will not be able to see any Part of the Staff, when the Instrument is set horizontal, which might as well be done alone, as in the foregoing Observations, in the Manner described in the Table of Curvatures.

For the common Occasions of Levelling to be performed without much *Apparatus* of Instruments, Time or Trouble, the following Method is recommended.

Set a Pole upright in a Spring, Pond, River, or other Place, whence Water is to be brought, and mark how many Feet and Inches of it are above Water.

Then set up another Pole of equal Length with the other in the Place to which the Water is to be brought.

Place the Centre of a Quadrant on the Top of this last Pole, so that the Plummet may hang free; spy through the Sights the Top of the Pole that is set up in the Water, and if the Thread cuts any Degree of the Quadrant, the Water may be conveyed by a Pipe laid in the Earth.

But if you cannot see from one Pole to the other, the Operation must be repeated.

Dr. *Halley* suggests a new Method of Levelling, which has been put in Practice by some of the *French Academy*: This is performed wholly by means of the Barometer, in which the *Mercury* is found to be suspended to so much the less Height, as the Place is farther remote from the Centre of the Earth.

Hence it follows that the dif-

ferent Height of the *Mercury* in two Places, gives the Difference of the Level.

Dr. *Derham* from some Observations he made at the Top and Bottom of the Monument, found, that the *Mercury* fell $\frac{1}{16}$ of an Inch at every 82 Foot of perpendicular Ascent, when the *Mercury* is at 30 Inches.

Dr. *Halley* allows of $\frac{1}{10}$ of an Inch for every 50 Yards; which considering how accurately Barometers are now made, an Inch in some of them being divided into 100 or more Parts, all very sensible, he thinks this Method sufficiently exact to take the Level for the Conveyance of Water, and less liable to Error than the common Levels.

The same Author found a Difference of 3 Inches 8 Tenths between the Height of the *Mercury* at the Top and Bottom of *Snowdon Hill* in *Wales*.

Of the proper Methods to be taken in adjusting the Levels or Falls from a Spring head, so as to conduct them by a gradual Descent to the House, or other Place required.

The Descent from the Spring Head to the Reservoir being taken, the next Thing to be done, is to determine what Fall the Water is to have, or in other Words, how many Feet or Inches, or how much Dependance is to be allowed to a Yard, to a Pole, to 100 Feet or Yards, or a Mile or Miles in Proportion, so as that the Water may have a proper Current

rent, and may at last not fall too low, but be brought gradually to the Top of the Reservoir or Pond where it is to be used.

But before we proceed to the Adjustment of the Dependence or Fall of Water, it will not be improper to enquire into the Fall of some Aqueducts and Water-courses, both at Home and Abroad, since 'tis from Fact rather than Theory and Speculation, that the certain Consequences of this or any other Employ must be deducted.

Vitruvius tells us, that the *Romans* allowed for the Channels or Sewers of their Aqueducts for every 100 Feet, running half a Foot of Declination or Sloping (which is near 27 Foot in a Mile) and if any Hills were in their Way, they dug thro' them, making Vents to give Air at convenient Distances; they not being apprized in that early Dawn of Hydrostaticks, that if you would confine your Spring in Leaden Pipes, it would rise over Hill and Dale, if the Spring-head were so high as to over-top them, proper Allowance being made for Friction, and the Interposition of Air, which may be let out by Wind-cocks, as some Authors have taught.

The so much famed Aqueduct of *Claudius*, was (as Mr. *Addison* informs us) five Foot and a half in a Mile; but whether he means an *Italian* or *English* Mile does not appear; but if it be an *English*

Mile, Experience informs us it is an Allowance large enough, tho' it were not to be above a Foot Fall in 1000.

Varenius in his *Geography* relates, from some *French* Writers, that the *Seine*, out of which the Water is carried from the *Armory* at *Paris*, to the *Royal Gardens*, is scarce one Foot Fall in 500 Fathoms, every Fathom being 6 Foot; now 500 being multiplied by 6, the Product is 3000 Feet, which is half a Mile, and 260 Feet, if accounted in the *English* way; by which it appears that the Fall is about two Foot in a Mile: but later Experience shews, that Water will descend in less than that. The Water-course at *Plymouth* is said to be but five Inches in a Mile-Fall; and one made some Years since, by Mr. *Stephen Switzer*, for the *Earl of Coningsby*, but about four.

The *New River*, according to the Relation of Mr. *Mills* the chief Surveyor of that Work, is in the mean, but between 3 and 4 Inches Fall in a Mile; tho' in some Places it be more, and in others less: And Sir *Jonas Moore* is said to allow but 3 Inches; and the same is practised in the Fens of *Lincoln* and *Cambridgeshire*, where the Water is almost of a deadish Flat; but the general Allowance is 4 Inches and a half by all Ingeniers.

To conclude this, the conducting of Water varies according to the Conveyances in which it is carried,

Water conveyed in Pipes, especially if they are small, requires more Dependance than any other Way, on account of the Friction there is against the Sides of the Pipes, as well as Wind-boundness that generally they are liable to.

That which is conveyed in Drains, will pass more easily and freely; but Water passing in an open Carriage, will pass the most free of all; except the Winds are against the Stream, because of that continual Agitation and Pulsion that there is in the Air.

But to come to Practice: Suppose the Length the Water is to be conveyed is 1000 Yards, and the Fall from the Spring-head to the Reservoir or Houle, is 25 Foot 9 Inches, and it should be required to know how many Inches or Parts of an Inch must be given to every Yard or Pole, in order to give this Water its proper and gradual Descent or Fall.

In the first Place, you must reduce the 25 Foot 9 Inches into Inches, which make 309; but those not being brought into Terms low enough to be divided by 1000, you must reduce the 309, multiplying by 12, to bring it into Lines or Parts of an Inch, the Produce of which will be 3708, as is seen by the Operation.

$$\begin{array}{r} F. \quad \quad In. \\ 25 : 9 \\ 12 : 0 \end{array}$$

$$\begin{array}{r} 300 : 0 \\ 9 \end{array}$$

$$\begin{array}{r} 309 : 0 \\ 12 : 0 \end{array}$$

$$11000)3708 : 00$$

Which being divided by 1000 the Number of Yards contained in the Length, the Quotient will be 3 Lines $\frac{708}{1000}$ of a Line, which is near 3 Lines $\frac{3}{4}$, or a Quarter and $\frac{3}{4}$ of an Inch; however you may allow it a Quarter and half Quarter, which is 4 Foot 7 Inches in a Mile, and have to spare, and to answer for any Error or small Mistake that may happen in carrying on the Work.

Suppose farther, that the Length of this Fall of 25 Feet 9 Inches, be 4 Miles and a Quarter, and it is required to know how many Feet or Inches it is proper to allow in a Mile, or any Part or Quantity of a Mile?

First reduce the four Miles and a Quarter, into Quarters of a Mile, which making 9, by such Multiplication, divide the 25 Feet 9 Inches by 9, and the Quotient is the Answer.

Example.

EXAMPLE.

F.	In.
25	: 9
12	: 0
<hr/>	
9)509	: 0(34 $\frac{1}{3}$
39	: 0
<hr/>	
34	: 3

And the Answer is $34 \frac{1}{3}$ Feet, or two Foot 10 Inches $\frac{1}{3}$; and so much must be allowed for the Fall in a Quarter of a Mile, which is 1 Foot 5 Inches in a Furlong; and a little more than one Line or one Twelfth of an Inch to a Pole, and 11 Foot and $\frac{1}{2}$ in a whole Mile, a very good Dependance for the Passage and Conveyance of Water where it can be had.

But there are other Things to be considered, in relation to the Conveyance of Water in Pipes, *i. e.* Friction, Wind-boundness, &c. because as M. Mariotte observes (and that from curious Experiments) that Water never rises to its own Level, on account of the Friction that is on the Sides of the Pipes, which Friction increases the longer the Distance is.

Now to adjust this Stoppage or Friction as near as may be, the general Rule among Workmen is to allow one eighth of the Height for the Interruption it meets with in its long Passage.

So that if the Descent from a Spring-head to the Reservoir be 128 Foot, you are according

to this general Rule, to divide it by 8, and the Product will be 16.

Which shews that the Water will not rise so high as the Spring-head by 16 Feet.

But Monsieur Mariotte (to whom we are so much indebted for his *Hydrostaticks*) has brought this Matter to a more exact Calculation, producing it as a certain general Rule, *That the Difference of the Height in Jets d'eau, or in other Words, the Descent of the Water from its Head to the Reservoir, or Place assigned for the Reception of it, is in a subduplicate Ratio of its Height.* And tho' 'tis certain, that he made Use of this Rule to demonstrate the Rise of Jets in the open Air; and as external Air has undoubtedly a greater Effect on the Rise of Water, than the Friction against the Sides of the Pipes, we may be the more sure, that if there be any Error, it is on the right Side, and that without any great Deviation from Truth, it may be applied to the Friction that is in inclos'd Pipes.

But to proceed upon the Foot of the foregoing Rule, it is, as may be seen in Dr. Desagulier's Translation of M. Mariotte, and which has been confirmed by undoubted Experiments, that a Spring-head five Feet one Inch high, will raise the Water 5 Foot, and that consequently the Friction that is allowed, is one Inch; and according to this Proportion the following Table is calculated.

A TABLE of the Heights to which Water will rise, proceeding from Reservoirs or Spring-Heads of different Heights; as also from five Foot to 100.

The Height of the Reservoir or Spring-Head.		The Height to which Water will rise.	
Feet Inches.		Feet Inch.	
5	I	5	0
10	4	10	0
15	9	15	0
24	4	20	0
27	I	25	0
33	0	30	0
39	I	35	I
45	4	40	0
51	9	45	0
58	4	50	0
65	I	55	0
72	0	60	6
79	I	65	0
85	4	70	6
93	9	75	0
101	4	80	0
109	I	85	0
117	0	90	0
125	I	95	0
133	4	100	0

It has before been observ'd, that the weakness of Water that runs a great way, is a great Deal more in Proportion to the Length it runs, than to any other Cause, it being found by Experiments (as the learned and ingenious Dr. *Desaguliers* tells us) that this diminution or weakening of the Water, diminishes rather in Proportion to the Length it runs, than to the Friction against the Sides of the Pipes.

But as this Diminution is

Fact (let it proceed from what Cause it will) and as all Motions do decrease in Proportion to the Spaces through which they pass, it will be proper to endeavour after a Determination, as near as possibly we can, that we may come the nearer to the Truth of our Calculation, in the giving this requisite Dependance to Water, that is to run from a Spring-Head to a Reservoir, either in Leaden or other Pipes.

And since this Diminution or
Stop-

Stoppage is (as all other Motions are.) in a subduplicate Ratio to the respective Spaces through which it passes, let us suppose, that as Water that falls from a Reservoir of 133 Foot high, rises but to 100 Foot

at a 1000 Yards Distance, and that this Diminution beginning from thence, increases gradually, suppose four Inches at the first, and so on according to the fore-mention'd Ratio, then the Account may stand thus.

A TABLE of the Diminution or Decrease of Water passing through Pipes of great Length.

Length.		Decrease.	
Yards		Feet	Inches
1000		0	4
1500		0	9
2000		1	4
2500		2	1
3000		3	0
3500		4	1
4000		5	4
4500		6	9
5000		8	4
5500		10	1
6000		12	0
6500		14	1
7000		16	4
7500		18	9
8000		21	4
8500		23	1
9000		27	0
9500		30	1
10000		33	4

By which it appears that this Diminution will be 33 Feet 4 Inches in 10000 Yards, or about five Miles and three quarters or something more.

And this seems to be the least that can be allow'd, so that if that an exact Calculation were to be made from these Rules for the Descent of

Water, for the four Miles and a half in Length before-mention'd, it would come to agree pretty nearly with what I have been endeavouring to establish for a certain Rule, which will be visible from the following Example, which is summ'd up in two Lines.

	F.	I.
<i>Imprimis</i> The Friction of 25 Feet 4 Inches —	2	2
<i>Secondly</i> , The Diminution or Decrease in passing } through 8000 Yards, which is a little } more than four Miles and a half.	21	4

In all 23 : 6

But notwithstanding what hath been said of this Diminution or Stoppage in Pipes of Conduits, yet in large open Aqueducts, Rivers or Sewers, (where the Friction is not sensible) there will be no Occasion for this great Care in the Calculation of the Dependance of Water.

What is endeavour'd to be establish'd from these Rules is, that though Water in an open Sewer or Drain, may pass at four, five or six Inches in a Mile Fall, yet if it be to pass thro' Pipes of Conduit, you can't allow it less than five Foot Fall, and so the Aqueducts of *Rome* are, as is before observ'd.

And tho' I will not positively assert, that Water will not pass at all with a less Allowance; yet one may venture to say it will not pass freely.

It is plain by what has been before advanc'd, that one Foot in a Mile is Inclination enough for any River, Aqueduct or the like; it being a considerable Rule in *Hydrostaticks*, that the larger the Aqueduct or Pipe of a Conduit is, the less is the Friction, which may be so enlarg'd as not to be sensible at all.

These Things being premis'd in so plain a Manner, it may be easy for a Conductor

of Springs to avoid running into an Error in attempting to perform what it is impossible for him to effect. The next Thing to be proceeded upon is, the Work.

When Water is to be convey'd about 1000 Yards, and you know from the foregoing Rules how much Fall it is proper to give in a Yard, as is set down in the foregoing Example, *viz.* a quarter of an Inch, if you proceed by the Garden Level, and ten Foot Rod, which is as good a Method as any. Let your Level be a little above ten Foot long, and exactly at the ten Foot, nail on a Piece of Wood of $\frac{3}{4}$ $\frac{1}{2}$ of an Inch thick, and beginning about a Foot or two below the common Surface of the Spring, as it is in the highest and best Seasons, or exactly at the Mark, as it is at the lowest; keep that level on which the Piece of Wood is nail'd, always from the Spring, and that will give the first Dependance.

You may, if you please, turn over the Level three or four times, and drive good square Stakes down, so that they may remain some time: and if you can see any great Length, you may with boning-Staves, (with which a good Workman should never be unprovided) bone quite through

through that View; but if you are oblig'd to go winding, then you must turn your Level over and over again, and your Level ought to be so conducted, as that the Stakes may stand just upon the Brow of the natural Ground; that your Pipe may not lie within above three Foot of the Surface; or if it be an open Sewer, you may not break up above two or three Foot, nor dig above two or three Foot deep in all sideling Ground.

To effect the same by the Water or Spirit Level, you must stand at the Spring-Head, and having turn'd your Instrument on the hanging Level, or in other plainer Words, on the Hang of the Hill where the Water is to pass; let your Assistant set forwards with a ten Foot Pole or Rod in his Hand, and holding his Hand at about four or five Foot high, let him move up and down the Hill, till the Level exactly strikes the Assistant's Head; and if you can carry it strait, let this be 70, 80, 90 or 100 Yards, more or less, according to the quarter of an Inch to the Yard Fall, as is before specified; which supposing to be 80 Yards, you are to allow ten Inches lower to your Gage; take and bone in new Pins or Stakes at every 15 Foot asunder; from which Gage you are to dig your Cut three Foot deep to lay your Pipes in; or if it be a bank'd River or Sewer, you are to throw your Stuff in all sideling Ground to the lowest Side, letting this Stake be in

the middle of your Cut, whether it be either of 15 or 20 Foot, either of which are sufficient in Works of this Kind.

What is to be further observ'd upon this Head, is, that you are to creep along the Side or Precipice of the Hill, if it be for an open Sewer or Drain to be made of Brick or Stone, and to be as exact as you possibly can in your Level; but if your Conveyance be of leaden, wooden or earthen Pipes, and the Springs lie so high, as that you can command any Hills that lie between it and the House or Reservoir to which you are to carry it, and can by the Rules before given be sure, you can carry the Water over them, you may go the nearest way.

Of the conducting Water by Aqueeducts, Drains, &c.

Running Water conducted in Aqueeducts, is certainly to be prefer'd to Water rais'd by Engines, because Repairs, which hinder the coming in of the Water, are not so often needed, and also the Water may come easier and in greater Plenty, than when it is rais'd by Engines and brought in by Pipes; besides the Expence is generally larger in doing it at first, as well as the keeping it in Order afterwards.

Vitruvius informs us, that the Ancients in order to the bringing of Water to Towns, Cities, &c. after they had taken the Level, conducted it three several Ways, by Aqueeducts,

ducts, Pipes of Lead and earthen Pipes, bak'd in a Potter's Furnace.

The leaden Pipes were at least nine Foot long, and they made them of bended Sheets or Plates of Lead, of different Thicknesses, according to the Proportion of the Largeness of the Pipes; these Pipes had likewise their necessary Declination or Sloping, and if any Valley was in the way (tho' by an unnecessary Expence) they made it equal to the Level with a Wall: they likewise had many Vents to give the Water Air, and to know where to mend the Pipes, when they wanted repairing.

And these by the Description given of them, are much stronger than the Mould Pipes now made.

The Ancients (as has been before intimated) chose rather to bring their Water in large Aqueducts, that were so high, that a Man might go upright, in order as it may be suppos'd, to mend the Pipes, and had three or four kinds of Water brought from different Springs for different Uses, in different Pipes; so that the whole Structure of their Conveyances for Water, was of an immense Height, and brought at an immense Expence, which had certainly the good Effect of keeping the Water clean and pure, as it came out of the Spring; whereas Water that is brought in open Carriages, as that of the *New River* to *Islington*, and other Waters are, is subject to be rendred foul by

Land Floods, and to receive a kind of muddy Taste and Tincture from the several Soils through which it passes, in those so great Distances it is usually brought.

But as these are immense Expences, and such as are scarce consistent with the Purse of any, but the greatest and most opulent Princes and States; and as such inclos'd Aqueducts with Pipes, some of them but of a moderate Size, are not likely to supply Gardens and Cities and Towns with such large Quantities of Water, which are there wanted, these open Carriages are absolutely necessary, especially where the Property of the Ground thro' which you bring them is easily to be come at; that they are to be approv'd on before inclos'd Aqueducts, both as to the Cheapness, and also as to the Quantity of Water they convey.

To all which we may add, that altho' the Water may be rendred sometimes a little thick or muddy by Land-Floods, &c. yet by the Influence of the Sun and open Air, it is at the same time rendred sweeter, and freed from those corroding Qualities, that often render them injurious to Man, Beasts, Plants, &c. all Plants thriving better by Water that is taken out of Ponds or Rivers which run gently, than out of cold Springs.

The next Thing to be considered, is the *Profile* or Dimensions of such an open Current or Course of Water; after which I shall consider the inclos'd ones of more ancient

which do indeed bring Water to any Place clearer and less turbid, and therefore the fitter for drinking, &c.

The *Profile* or Depth and Breadth of such Carriages, may be according to the Quantity of Water you want, or according to the Supply you have, tho' it should scarce be less than four or five Yards wide at the Top, and four Feet deep. that there may be Room for that Sediment, which Water naturally obtains, by running through Soils of different Qualities; besides such a Depth requiring Banks that are sloping, to which there ought not to be allow'd less than one and a half or two Foot horizontal for one Foot perpendicular; less width than that, will not do well; but if it is design'd to be a navigable Channel for larger Boats, then you ought not to allow less than 30 or 40, as the Canals that go between Town and Town in *Holland* generally are.

I shall now give some Direction how this open Carriage or Drain ought to be made.

In the first Place, you ought to keep up as much as you can in the whole Ground; and by the Side of such Hill or Valley that lies near you; for that no Banking can be suppos'd of equal Solidity and Security with settled Ground; also all Sorts of Trees must be clear'd away, for the Roots of old Trees will rot and let the Water out, and the Roots of young Trees will be equally injurious; in that they will by the blowing of the Wind loosen the Banks

to that Degree, that much of the Water will run to waste there: to which may be added, that rocky Ground, Fox and Rabbit Earths, are Soils not proper for such Works.

If good Clay can be procured near at Hand, it is requisite it should, especially where there is a Necessity of raising Banks entirely new, or for the stopping of Rocks, Fox or Rabbit Earths, &c. but in other Grounds, where Passage is through that which is whole, there will not be Occasion for that great Care; especially if your supply be any Thing considerable; but one of the chief Cares will be to close your Joints well between your new and old Ground, and when you build new Banks on old Ground, you must not fail to go down with your new Clay or Ballast, two or three Foot lower than that Ground, and two or three Foot wide, and you must always mix your old and new Ground together with a Tothing, after the same Manner as Bricklayers do, who leave it for one Brick to join to another.

It is certain, that whether it be Ballast or strong or indifferent Clay, it is very necessary to ram it; or to lay the *Strata* but a Foot thick at a time, or thereabouts causing the Labourers to tread or wheel it over, keeping as exact a Slope towards the Trench, as if it were for a Garden, and it will be proper to fill all hollow Places with waste Earth; not so much for saving or holding Water, as for giving a proper

Base and support to the Foot of the Bank.

The inward Sides of the Slope of the Bank, should also be well beaten with a large Hedge Stake, before they are pared with a Spade, which ought to be done. You should not allow less than six or eight Inches, or a Foot in a Mile (if it can conveniently be had) Dependence; but for certain four or five Inches is absolutely necessary.

The next Method of conducting *Water*, is what was us'd by the Ancients in their inclos'd Aqueducts: but this (as has been said before) is so very expensive, I shall say but little of it here; but refer any curious Persons to the Writings of *Fabretti*, which may be had at some Booksellers, and from him *Monsieur Montfaucon*, who has given the Draught of the famous Aqueduct of *Metz* and some others; nor are the Works of *Vitruvius*, *Palladio* and other Architects of *Rome*, to be pass'd by on this Occasion.

But to come to the Works made use of by the Moderns.

The first is that of Aqueducts made of Brick or Stone, in neither of which do the Moderns run to that Expence the Ancients did, neither making them so large, nor any way so expensive.

A Drain of a Foot square on the inside, made with either of the two Materials, Stone or Brick (but Brick is the dearest) the other not costing above 10 *d.* or 12 *d.* a Yard, as a modern Hydraulist says, tho' at that

Size they will convey vast Quantities of Water; but the greatest Inconvenience that attends them, is that if the Water is to be convey'd a-cross a Valley from one Hill to another, these Drains of Stone or Brick will not do it, and can only be us'd where the Water is to run strait, or is to turn round upon a Precipice or Side of an Hill upon one Level.

Indeed wooden Troughs may be laid a-cross Valleys supported with Frames of Wood; but these are attended with many Inconveniencies; as the Drought in Summer which will chap and tear them to Pieces; so that the Water will be in Danger of being lost, or the Trough liable to be cut or broke to Pieces, by mischievous Persons; in all which Cases Under-ground Conveyances in wooden, leaden or earthen Pipes are the best.

But wherever a Drain can be carried strait (or even round) and the Declination is easy and gradual, there Brick or Stone Aqueducts and Conveyances are the best and cheapest; especially where the Spring is large, as six or eight Inches Bore, which then must also be laid in very good Mortar in the Spring, and be suffered to dry before the Spring is turn'd into it; it must also be bedded in Clay; and when it is cover'd over at the Top (as it ought to be) with flat Stone, you must ram in Clay on both Sides and Top of the same, to prevent the issuing out of the Water.

But the Brick Drain is the next in Course; these cannot

well be made above six or seven Inches square in the Inside, because a good large Brick which is laid at the Bottom and Top, is not above nine Inches long, and it must lap over an Inch on each Side at the Top, and at the Bottom there must be a Stretching Brick on each Side, to support the Side Wall and Back, or rather the End. The Construction of this Drain you may see *Plate, Fig. 4.* where the Bricks are plac'd header and stretcher, in the Manner they are when made into a Drain; the middle Brick mark'd A, may be any broken Bricks.

Every Yard will take up about 75 Bricks, which at 18 *d.* per Hundred, comes to between 13 and 14 Pence, and the Lime and setting may be worth about Two Pence, and the Digging and Claying a Groat or Five Pence, in the whole about 20 Pence; and perhaps in some Countries where Materials and Workmanship are cheaper, it may be done for 15 or 18 Pence a Yard.

But there is yet another cheaper way of Brick-Drain: and that is when a Hollow or Semi-Circle of two or three Inches in Bricks, is made about four or five Inches thick, and the usual Length.

These Bricks when plac'd together, and when set in Terras or very strong Mortar, well dry'd before the Drain is us'd, is the cheapest and most durable Method of any for Conveyance of Water; about eight Bricks will do a Yard, which

Bricks are worth 3 *s.* per Hundred, the eighth Part of which is 4 $\frac{1}{2}$ *d.* and the digging and laying and Mortar, may be worth about 3 *d.* or 4 *d.* more, and this is the cheapest Method of all; but must be laid in Clay, as all other Drains and Pipes should be.

Of the several kinds of Pipes for the Conveyance of Water, whether Lead, Iron, Earth or Wood.

Vitruvius informs us that the Ancients had but two Sorts of Pipes for the Conveyance of Water; the first were made of Lead, which was of Sheets nine Foot long, and turn'd in at Top, not unlike some made in *England*, especially for *Esq. Dodington* at *Gunville* in *Dorsetshire*, by *Mr. Watts*, a Plumber of *Brackley* in *Northamptonshire*.

These Pipes are join'd together without Solder, by what are by the Workmen call'd Flankets, which are Rings made of Iron, that may be screw'd as tight as you please at the Joint; the Nose of one Pipe going into the Tail of another; and in order to keep the Water from getting out at the Joint, there are proper Bandages of Leather that close it up by the Compression of the Flankets, under which may also be put Tow made of Hemp, dipp'd either in Oil, Pitch or Tallow, which will make a close Cement to keep the Water in, and over which the said Flankets are screw'd.

These

These kind of Pipes are much preferable to those made in Moulds, because they are cast without those Flaws and Holes, which often happen in moulded Pipes; and as they are turned in at Top and burnt (as it is termed by Workmen) they are much stronger.

Nor is there that Expence in Solder (besides many other Advantages, which will be mentioned elsewhere) which is in other Pipes.

It is true, they are dearer than other Pipes are, and are chiefly fit for such as have well furnished Purfes, but then they are far more durable.

But the cheapest kind of Pipes, which are now in use, is those made of Earth; for which Mr. *Edwards* of *Monmouth* has a Patent: *Vitruvius* tells us, that the *Romans* had such kinds of Pipes made of Potters Clay, two Inches thick, and joined together with Mortar mixed with Oil, and when they had a Joint to make, they made use of a Red Free-stone, which they pierced thro' to receive the two Ends of the Pipes, and to strengthen and secure them in the Nature of a Bandage.

It is related, that some of these Pipes have been found about the City of *London*, which by several Circumstances are supposed to have been laid by the *Romans*, when they inhabited this Island; but the Joints of these were secured by a Piece of Sheet-lead, which was wrapped round the Joint; some such have been said to be taken up

in *Hyde-Park*, belonging to the ancient Water-works there.

These Earthen Pipes now made by the said Mr. *Edwards*, are about 3 or 4 Foot long, and not above half an Inch thick; but they are so exactly made and fitted in the Joint that no Water can come out of them.

The Price at which they are sold, is from 1 s. to 2 s. or 2 s. 6 d. per Yard, and sometimes cheaper, according as they are in Diameter; and are very useful in all such Places where they can lie free from being gone over by Carts and Coaches.

But besides what are made by Mr. *Edwards* in the Country, there are others made by Mr. *Aaron Mitchel* of *Vauxhall* for the said Patentee; these are excellently good, he having been one of the first Inventors of them.

There was a Trial of these Pipes made at the *Tork-Buildings*, before Dr. *Desaguliers*, and the Plumber of the Works themselves, when being fairly tried with all the Compression of Air, and that Engine could lay upon them, and without making the least Fracture, either in the Pipes or the Cement which joined the Pipes together, a general Account of which was published in the *Evening Post*, of *August* 1. 1728.

These Pipes are made of a Sort of Clay equal to that of which the Tiles of the Ancient *Romans* were made, are also used in the Insides of the Walls of Houses, and are affixed likewise to the Outsides of the

same in the manner as Lead is; even from the lowermost to the uppermost Floor; and receive and discharge the Water from the Roof and Gutters of such Houses, as effectually as any Pipes made of Lead or Wood, and the Price of them scarce amounts to one sixth Part of those of Lead, nor more than one half the Price of those of Wood.

There are also many other Sorts of Pipes which have been used by the Moderns, which were, (as appears by what *Vitruvius* has written) intirely unknown to the Ancients, such as those of Wood, as Alder, Elm, Oak, Beech and Iron, the last of which are used in *France*, more than in any other Place) but have not, till of late, obtained in *England*.

Pipes made of Alder, are the cheapest of all, tho' they are not indeed the strongest; the boring of the Wood being not worth above 10 *d.* or 12 *d.* a Yard; but the Diameter of such Pipes is generally but small, about an Inch and half, and two Inches, being the utmost Bore it is capable of having; nor is it strong enough to bear much Force; but only to conduct a small Spring a small Length, and upon a gentle Current.

The Pump-makers and Pipe-makers about *London*, make use of Fir for Pipes, where the Stream is not great, which boring easy, is cheaper than that of Elm; but then on the other hand, it is not so strong or du-

rable as Alder Pipes are, and is only fit for Works, where neither the Rise nor Declivity are either of them great.

Elm-pipes are much stronger than any of the former, and of known use for the Conveyance of Water, because it will lie longer under Ground in the wet and Water, than any other Sort of Pipes of Wood, (Oak excepted) will.

Now these being generally made of small Trees and Saplings, of different Diameters, they are also different in Prices: because they will according to their Size, be either stronger or weaker, and of Consequence bear either a greater or a lesser Force, that proceeds either from the Force or Lifting of a Wheel, or the Cylindrical Weight of Water, which lies upon them, where Reservoirs lie high; and the Reason that Water Works often miscarry, is for Want of Care and Judgment in this kind of Pipes, by making the Bores larger than they ought to be, and the Outside or Shell too thin, especially in veiny crooked Trees.

Elm, says a modern ingenious Author, may be cut down, hewed or bored. from 8 *d.* 10 *d.* 12 *d.* to 16, 18, or 20 *d.* a Yard, running Timber and all, 5 or 6 *d.* a Yard, boring being a sufficient Allowance.

He tells us, he has examined the Prices of Elm-pipes about *London*, and finds as before hinted, that they are according to the Thickness or Strength

Strength of the Pipes, which according to the Weight they ought to be either more or less, are to sustain.

These following being the Sizes that are generally used, the Prices, taken at a Medium, are,

		s.	d.	
2 Inch Pipe	} is worth about	1	:	3
3 Inch Pipe		2	:	0
4 Inch Pipe		2	:	6
5 Inch Pipe		3	:	0
6 Inch Pipe		4	:	6
7 Inch Pipe		5	:	0
				} per Yard.

Those who make the most Objections against Elm-pipes, urge, that there is a great Waste of Water at every Stroke of the Engine, which forces the Water, with great Violence, thro' the Pores of the Tree ; but this Objection is answered, by the Supposition that it is an Ease to the Work, and not at all different from Nature ; but rather a Relief than a Burden to the Machine, and the Passage of the Water in the Pipes ; which in closer Bodies is frequently so wind-bound, that it won't pass.

There is another Convenience which attends these and all other Wooden-pipes ; and that is, that you may at any Time, when the Pipes are wind-bound, which they often are, when they lie long in the Ground unus'd, that then you may bore a Hole at the very Place where you perceive the Stoppage to be, which is what cannot be so well in other Pipes which are made of Metal.

There is another Sort of Elm-pipes, which some sup-

pose to be as strong, if not stronger and more durable than the former, and these are square Pipes made of Elm-plank.

The Boards of which those Pipes are made, are generally about 10 Inches square, and an Inch and 3 quarters thick ; but they may, if you please, make them a Foot or 14 Inches square ; but then they ought to be 2 Inches, or 2 Inches and a Quarter, or 2 Inches and a half thick.

The Sides must be well grooved into the Bottom and Top, and the Joints well pitched or stuffed with Tow or Hemp, dipped into Pitch and Tar, to keep the Water from oozing out ; after which they are to be banded and collared, at about 5 or 6 Feet asunder, with Collars or Bands made of Elm Slabs or Planks, cut out of the Sides of the Elm, and this will be stronger and more durable than any other Bandages are, and will save Iron-hoops, which are expensive. This is said to be the Invention of *John Thyrle Ernby, Esq;* of *Wbetham, near Sandy-lane,* Wilts.

Wilts, in the Road to *Bath*.

A Board or Boards of 10 Inches square, will when well groov'd in at Top, make a square Pipe of about 4 Inches and a half, or 5 Inches square, which last is near equal to a circular Pipe of 6 Inches Diameter.

In order to proceed in this Work, you must be provided with Tow or coarse Hemp, as also Pitch and Tar, and dipping the Tow or Hemp into the Tar, put it into the Groove or Joint, and then let the Workmen knock the Boards together in the Groove, with all the Might and Strength they have; the Security of the Water in the Pipes consisting in the Closeness of this Joint.

When this has been done, then the Collar or Bandage is to be put on at each Joint, the

Boards being about 9 or 10 Foot long, and another Collar in the Middle; putting the small End of one (so made as is done in Elm-pipes which are so bored) into the great End of the other.

The Conveniencies of this Sort of Conveyance for Water, are, that it is stronger, and also may be made 5, 6 or 7 Inches square, which will carry more Water than bored Elm-pipes of the same Diameter.

In the next Place, there is less Depopulation and Waste in cutting (a few large Elms at full Growth, being sufficient for this Purpose) whereas when they are cut down small, there is great Waste made; and in the last Place, it being all Heart, it will not be so subject to break or burst as Elm bored will.

Here follows the Expence of 330 Yards running, perform'd in the County of *Wilts*, by Mr. *Switzer*.

	<i>l.</i>	<i>s.</i>	<i>d.</i>
For 20 Tun of Timber at 30 <i>s.</i> per Tun	30	: 00	: 00
Felling and hewing of <i>Ditto</i> , at 8 <i>s.</i> per Tun	08	: 00	: 00
For Workmanship 330 Yards, at 4 <i>d.</i> per Yard.	05	. 10	: 00
For Nails, Tar, Tow, or Hemp, Banding, Collaring, and laying included at 3 <i>d.</i> per Yard.	04	: 02	: 06
<hr/>			
	47	: 12	: 06

By which it appears that the whole 330 Yards comes to 47 *l.* 12 *s.* 6 *d.* which being reduced into Shillings, Pence and Farthings, and divided by 330 Yards, it comes to about 2 *s.* 10 *d.* a Yard; whereas Lead-pipes of such Dimension

would cost at least 20 *d.* a Yard, and bored Elm, five or six Shillings.

But supposing the Workmanship (as it is) too little by 2 *d.* a Yard, it will be vastly cheaper than either Lead or Wood.

Another

Another Sort of Wooden-pipes are made of Beech, which being of a more firm and solid Contexture, and not so porous as either Elm or Oak, will lie under Ground longer than either of them, as may be seen in all Mill-work, in which this Wood is much used; but like many other Woods, has an Inconveniency attending it, that it bores pretty hard, is brittle, and not so tough grain'd as Elm or Oak is; besides the Boughs don't run in the general so strait as Elm does, and therefore the Shell of it ought to be very thick, not less than five or six Inches to keep it from bursting; and for that reason the Bulk or Dimensions of it ought to be 12 or 14 Inches Diameter, one with another, when you may venture at a Pipe of two or three Inches bore, and tho' it is something difficult to bore, yet the Water will be less subject to ooze out, than at any of the others, Oak it self not excepted.

These Sort of Pipes, the Property of the Wood, digging the Trench, boring, laying, claying and banding, will be worth 3 s. or 3 s. 6 d. per Yard, for a Bore of 4 Inches, and so on proportionably less, as the Wood or the Bore is less: but then it must be observed, that it is the nearest the Goodness of Lead of any Thing that is a 4 Inch Pipe, which of Lead will cost 15 or 16 s. as will be made out anon.

The very last kind of Wooden Pipe is Oak, which indeed is very strong, and lasts a great

while, there being some Trees of that kind which were dug out of the Foundation of *Blenheim* Bridge, (as Mr. *Switzer* says, when he was Supervisor there) that were, tho' as black as Ebony, yet as sound as *Brazil* it self, and might in all Probability have no other Date than that of the Deluge it self. But as the Limbs are generally crooked, and that all the young Bodies, together with the whole Timber it self, is too good for those Purposes, there is no need to say any more of it upon this Head.

The next Sort of Pipes to be spoken of, are those made of Potters Earth; there are at least 2 kinds of these; they are of two Thicknesses in the Shell, the first being the most in use in the Country, is not above the Thickness of two Crown Pieces at the most; but this is so thin, it is only fit to convey Water a little Way, where the Fall is not great. These are said to be bought in many Places in the West, for 6 d. a Yard.

The other is the new invented ones already spoken of, which nevertheless are not above half an Inch thick in the Shell; the Potter who makes them being of Opinion, that a greater Thickness would be entirely useless; or perhaps the true Reason may be, they can't burn them so well.

These indeed are excellent Pipes well glaz'd on the Inside, as they ought to be, to keep Water sweet; and how they will perform in Force-work, an Account

Account has already been given.

Indeed some Persons say, there is indeed a Weed apt to grow at the Place, where they are jointed together, the Fibres of which are apt to choak the Pipe; but this, if true, may certainly be prevented; by putting on a thin Bandage of Lead round the Joint, or a Collar of Stone and Wood to strengthen them, you may prevent that Mischief.

The Manner of mending them, when broke, has been another Objection, that has been made against them; for if the Joint be made of such a Cement, as that the Pipe will break any where, rather than there, it does not seem easy to say, how they will be mended. But in Answer to this, the Joints of those Pipes made at *Vauxhall*, will shoot so close together, that there is little Occasion for any Cement at all; but if they do, Tow dipped in Pitch and Tar, or any other Cement of that kind, will effectually stop it, at least the Loss of Water will not be great, where the supply is any thing large, and then they may be uncollared and mended at pleasure.

There is one Thing however to be minded; that is, that they will not serve in High-ways and Streets, where Carriages and Coaches are to cross them; but on all other Accounts they are not only cheap Conveyances, but also excellent Pipes.

Of all Sorts of Pipes for the Conveyance of Water, that of Lead is preferable (especially those which are made of Sheet-

lead and burnt at Top, if it were not for the Expence, because they are more pliable to lay up and down Hill, and may be also more easily and firmly jointed to one another; or, as durable as any, and if well cast, of a much closer Contexture.

In Pipes of Conduct, and where Water is carried a great Way, these Pipes ought to be 6 or 7 Inches Diameter, but must not be less than 4 or 5; because in Pipes of that Size, there is less Friction and Wind-boundness than in those that are smaller, and consequently the Water will flow the better, and more regularly rise up to the Height of its first Head, and also in greater Quantities.

It must indeed be own'd, that a Pipe of Conduct of so large a Dimension of 6 or 7 Inches, is such an Expence as few Gentlemen, or even Noblemen will be willing to be at, in very great Lengths, where the Expence is almost immense; Pipes of that kind, without a Shell of Thickness proportionable to it, being worth from 25 to 40 s. a Yard, according to the Height of the Reservoir, or the Force of the Water they are to sustain.

Therefore a Pipe of Conduct of the cheapest Kind, must be at least 4 Inches and a half, or 5 Inches Diameter, and such will not cost less than 16 or 18 s. a Yard. And for this Reason, in many Places, they have reduced their Pipes of Conduct to three Inches Diameter, which is indeed too little. This

it is true, reduces the Expence to 10 or 12 *s. per Yard*, according as the Price of Lead is.

Suppose Lead, casting of Pipes, and all is reckoned at 22 *s. per Hundred Weight*, the Calculation may be as follows.

To a Pipe of 3 Inches Bore, is usually allowed 45 Pounds a Yard; and this is worth about 9 or 10 *s. per Yard*, when Lead is worth from 22 to 45 *s. per Hundred*, allowing for Waste.

To a Pipe of 22 Inches, 3 Quarters, 40 Pounds is allowed, which is worth between 8 and 9 *s. per Yard*.

To a Pipe of two Inches and a half, 36 Pounds is allowed, and then it is worth about 7 or 8 *s. per Yard*; but it would be proper to add 5 Pounds more to every Yard, tho' it does add something to the Expence.

To a Pipe of two Inches Diameter, there is allowed usually 30 Pound of Lead, and then it is worth about 6 *s. per Yard*.

But of all the Pipes of Lead, of what Size soever, those that are joined by Flankets (as has been already mentioned) are the best; because they may be easily taken up, and scowred or cleansed, whenever there is Occasion.

Because as *M. Mariotte* observes, there is, even in the finest Water, a Sediment, which will in Time petrify, incrustate and grow hard, and will stop up the Pipe, which can never be cleansed again, where the Pipes are soldered together at the Joints with Sol-

der, as Pipes generally are. And this (among some others) is one of the Inconveniencies which attend all Water-works, and is the Occasion of their being spoiled.

Notwithstanding something has been already said, concerning the Lead proper to be allowed to Pipes in general, according to the Proportion or Diameter of their Holes: but when Reservatories are very high, or Water is raised by an Engine to great Heights, or carried to great Distances, there Pipes of Conduct are in great Danger of being often broke, if the Shell is not thick enough, especially up and down Hills, and through deep Vallies, and it would render a person very uneasy, after he has been at a great Expence, if his Pipes should happen to burst thro' the Defect of the Solder, or the Weakness of the Pipes. At the same time, Care should be also taken, on the other hand, not to make them thicker than is absolutely necessary, since a small Addition in long Lengths would greatly enhance the Price.

But it is requisite, that we should know by Experience (as well as from what *M. Mariotte* and others have delivered upon this Head) that the Thickness of the Metal or Shell of the Pipes, be increas'd or diminished in Proportion to their Diameters, the Heights of the Reservoirs from which the Water falls, or the Height to which it is to be raised by Engines; and last of all, the Lengths

Lengths or Distances, which Water is to be carried : All which adds to its cylindrical Weight ; and of Consequence the greatest Thickness of Metal in the Pipes.

As for Example, according to Mr. *Mariotte*, when a Reservoir is 60 Foot high, and the Pipe 3 Inches Diameter, the Metal must be half an Inch in Thickness, which is the 24th Part of a Foot ; but as it is not to be doubted, but that M. *Mariotte* means Copper, which is harder, stronger and of a closer Contexture than Lead, therefore 3 or 4 whole Lines, which is one fourth or third Part of an Inch, will be Thick-

ness little enough, and for a Reservoir 100 or 120 Foot high, a whole Inch, because of its great Height.

If the Pipes are both wider and higher, then the two Proportions must be also observ'd : Thus,

If a Pipe comes from a Height of 60 Foot, and the Diameter be 6 or 8 Inches, you must take the half Line in Copper, according to M. *Mariotte*, or rather 3 Lines or the Quarter of an Inch in Lead, because of its Height of 60 Foot ; and for the Thickness, you must work by the Rule of Three, saying,

If 9, the Square of 3 Inches, require 3 Lines thick of Metal, What will 36 the Square of 6 Inches require ?

E X A M P L E.

As 9 is to 3, so is 36 to a fourth Number required.

$$\begin{array}{r} 3 \\ \hline 9 \overline{) 108} 12 \text{ Lines is the Answer.} \\ 18 \\ \hline \end{array}$$

So that a Pipe of 6 Inches Diameter, when it comes from a Reservoir 60 Foot high, should be 12 Lines, or one Inch thick, near, or according to which, the following Table is calculated.

But first of all there is another Thing to be determined, and that is the Diameter of the Ajutages.

The Author of the Theory and Practice of Gardening, tells us, that it may be taken for a certain Rule, that the Bore of the Ajutage ought to be four

Times less than the Bore or Diameter of the Pipe of Condukt ; that is, it should be in a quadruple Proportion to it ; so that the Column of Water may be proportionable, and the Quickness of the Motion in the Pipes may be equal.

And besides (as has been already observed) there is too great a Friction or Wear in small Pipes, when the Quill is too big, and in the Bore of small Quills, when Pipes are too large : All these Things do also depend upon Calculations of

of this Kind, which will be necessarily included in a Table, where the Diameter of Pipes of Conduct, Thickness of Metal, &c. are contained.

Now the Calculations of M. Mariotte being supposed to be of Copper, Lead, not being so much used in *France*, as it is in *England*, it has been thought proper, by an ingenious modern Author, to pitch upon a Pattern of a Leaden one, which should determine all that is required on this Subject; which he tells us he has done from a

Pattern, which, by all good Judges, is accounted an excellent one.

The Pipe is four Inches Diameter, which is generally supposed a good Pipe of Conduct (tho' in some Cases more may be requisite) and about equal to the Expence that most Noblemen and Gentlemen may be willing to be at.

The Thickness of the Metal which is of Lead, is 6 Lines or half an Inch, to regulate then the Thickness of other Metal to it, say as before :

If 16, the Square of 4 Inches, requires 6 Lines; how much does 36, the Square of 6, require?

EXAMPLE.

$$16 : 6 : : 36$$

6

16)216(13 $\frac{1}{2}$ the Answer.

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By rejecting the Fraction, it appears, that the Thickness of the Metal requires to be 13 Lines, or one Inch one Twelfth; and upon this Foot the said Author has formed the Column concerning the Thickness of

Metal in Pipes, which seems to be (without any considerable Variation) agreeable to Truth, which expresses also the Height that the Water coming from the Reservoir will rise. The following is the Table.

The Height of the Reservoir.		The Diameter of the Pipes.		The Thickness of the Metal.		The Diameters of the Ajutages.		The Height the Water will rise to.	
Feet. Inch.		Inches. Lines.		Lines.		Lines. Parts.		Feet. Inch.	
100	0	7	00	15 $\frac{1}{2}$	16	12 or 15		80	00
86	4	6	00	14	00	12	14	70	00
72	0	5 $\frac{1}{2}$	00	12	13	10	12	60	00
58	4	5	00	9	9	8	10	50	00
45	4	4 $\frac{1}{4}$	00	7 $\frac{1}{2}$	8	7	08	40	00
33	0	3	00	6 $\frac{1}{2}$	7	7	00	30	00
21	4	2 $\frac{1}{2}$	00	5 $\frac{1}{2}$	6	6 $\frac{1}{2}$	00	20	00
15	9	2 $\frac{1}{4}$	00	4	5	6	00	15	00
10	4	0	25	3 $\frac{1}{2}$	4	5	00	10	00
5	1	0	22	3	3 $\frac{1}{2}$	4	00	5	00

This may suffice as to the Diameter of Pipes of Conduct, the Thickness of the Metal, the Diameter of the Ajutages, &c. as are, or ought to be proportionable the one to the other.

But if any Person has a mind to have his Pipes of Conduct larger than any above mentioned, he may; this Table being chiefly calculated for all proportionable Heights.

Iron-Pipes now growing into great Use, and being, in respect to their Cheapness, the best Pipes, those of Clay excepted, which are now made, especially, if the Metal is well proportioned and melted, I shall add concerning them.

That it will be no great Advantage to cast them very small;

the best Sizes being from 7 or 8, to 5, 4 or 3 Inches Diameter; the first of which will cost about 20 s. a Yard, which is much about half the Price of Lead, and the lesser from 16, to 15, 14, 12 or 10 s. per Yard, according as they are greater or smaller in Bulk or Diameter,

These Iron-Pipes are the most durable of any yet mentioned; they are cast in Lengths of 3 or 6 Feet, and sometimes 9, and are joined together by Flanckets, as may be seen in the Water Works at London Bridge. These, if well made, will last, as one may say, for ever.

These Iron-Pipes are to be had of Mr. Bowen, at his Foundry, near Marigold-Stairs, Southwark.

As to the Method of making Reservoirs, Basons, &c. their Construction, Extent, Depth, and other Dimensions, take the following Directions.

Vitruvius informs us, that the Ancients, in making their Wells and Cisterns, to receive Rain and other Water, used to make them under Ground, and to a very large Extent; and Walls were built on the Sides and Bottom with Mortar made of strong Lime, Sand, and Pebbles, well beaten together; claying, as we may suppose, not being so well known to them, or to be had in such Quantities, as now it is.

Of these they made several, one after another, thro' which the Water was to pass, to the End, that the Sediment might remain (if any there was) in the first and second, and so that when the Water was arrived at the last, it might be clear. They likewise put Salt into their Cistern Water to make it more subtiler.

In this Manner were the remarkable Cisterns of *Roselayn* made, viz. with no other Materials, as has been already intimated, than Gravel and small Pebbles consolidated together, by a strong tenacious Cement, not improbably, such as Terras-mortar, or the like.

But a better and cheaper Way, is to have the Hills of the finest Sand, that can be conveniently procured, such as in its own Nature, is not subject to be dirty.

When the Water comes in, then let it be at one End, having 3 or 4 of these Sand-banks lying across the Reservoir, give the Water Time to filtre thro', and let the Pipe which is to supply the Fountain lie at the farther End. So you may expect to have your Water clear; and these Sand-Banks should lie, and be above the Surface of the Water when it is at the highest of all.

Nor can too great Care be taken in making those useful Reservatories, as daily Experience shews, especially if it be upon a dry Gravel, or sandy Bank, and is to lie above Ground, as is evident from that very handsome one behind his Grace the Duke of *Chandois's* intended Building near *Cavendish* Square, where the Expence of making and fitting it, has doubtless been very great.

As to the Form in which these Reservoirs or Basons are made, it is of no great Consequence, whether it be a perfect Square or an oblong (which are the best Figures) or any other; and as to their Extent, that ought to be according to the Quantity of Water that is required, 100, 150 or 200 Foot square, being sufficient in most Cases; tho' for large Cities, Towns, &c. 300, 400 or 500 is little enough.

But the deeper they are the better, contrary to the Practice of some Persons, who have made them not more than 3 or 4 Foot deep, when they ought rather to have been from 7 or 8, to 10 or 12 Foot deep, that
the

the Water may settle the better.

The Bottom also ought to be filled, 2 or 3 Foot high, with large Gravel Pebbles, by which Means the Sediment will have Room to lodge and settle therein; and this Bottom should be well clayed, and lie lower by 3 or 4 Foot than the Bottom of the Aqueduct, which brings the Water in for the Purposes before mentioned.

If the Reservoir be but small, as 15 or 20 Foot over, Mr. *Switzer* advises to make it in the Form of a Conoid; because by this Shape, the Pressure of the Water on the Pipe of Conduet will be regular and uniform from the Beginning to the End of the going out of the Water.

It is by this conoidal Form, that *Archimedes* in some Propositions in his two Books, *De insidentibus Humido*, demonstrates the Gravitation or Pressure of Fluids one upon another, which was also followed by *Galileo*, *Torricelli*, and others.

To the same Purpose also, *Mariotte* in his Rules for the measuring of spouting Waters, through Ajutages of different Bores, in his Treatise of *Hydrostaticks*, sets down a very curious Problem. This Problem is to find a Vessel of such a Figure, that being pierced at the Bottom with a small Hole, when the Vessel is small, but larger as a Vessel or Reservoir is larger, that the Water should go out, its upper Surface descending from equal Heights, in equal Times. This he says,

Torricelli has not undertaken to resolve.

Let it be a conoidal Figure, as *Fig. 1.* in the following Plate, where BL is to BN , as the Square squared of NO , and BN to BH , as the Square squared of NO , to the Square squared of HK , and so on; the Water will descend from ADC , in an uniform manner, till it come to the Hole at B .

For let BP be the Mean Proportional betwixt BD and BH since the Square squared of KH and of DC are to each other, as the Heights BH, BD , the Squares of HK, DC will be in a subduplicate Ratio of BH to BD , or as the Heights BP, BD .

But the Velocity of the Water that goes out at B , by reason of the Pressure of the Height BH in a subduplicate Ratio of BD to BH ; that is to say, as BP to BD : Therefore the Velocity of the Water descending from H , is to the Velocity of the Water descending from D , as the Square of HK to the Square of DC : but the circular Surface of Water at H , is to the circular Surface of the Water at D , as the Square of HK to the Square of DC ; therefore they will descend and run out, one as fast as the other: and if the Surface ADC runs out in a second, the Surface $G HK$ will run out in a second likewise, since the Quantities are as the Velocities.

The same Thing will happen to the other Surfaces at E and F , &c. But the Hole must in all

all minute Causes causes be very small, and that no considerable Acceleration may be made, and that the Water may not go throughout the Hole sensibly ; but in a Proportion to the Weight.

A Vessel of this Model, says the ingenious M. *Mariotte*, may serve for a *Clepsydra*, or Water Clock.

To this it may be added, saith an Ingenious Author, For any Reservoir for supplying and playing Fountains, or any other Water Works, in Gardens, or for the regular Distribution of Water for the Use of any City or Town, and as still the more useful, and proper to be made, when the Spring rises near the Place where the Water is to be used, as does that of *Long-Leat* in *Wiltshire*, the Seat of the Right Honourable the Lord Viscount *Weymouth*, and other Places.

The Section or Profile of a Reservoir being thus set down, pertaining as it does only to those which are narrow and deep, as all Reservoirs must be, which are made on the Side of a Hill, and near a Spring, it will be requisite to inform the Reader, that the Structure of such Reservoir or Cistern be of Stone or Brick, since there is no working of Clay, to stand in so perpendicular a Manner, as the Figure describes.

But when Reservoirs are made of that great Extent, which they often are, this Profile or Section can be of no great use, nor can the Figure of it be followed.

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I shall therefore lay down a short Account of those Rules that are necessary to be observed in the Profile and Disposition of Reservoirs, that are made of Clay, and the Methods of digging, picking, cleansing, beating or ramming of that useful Material.

The Steps then on each Side, and on the Ends of any Reservoir, if the same be made of Clay, which is the cheapest Material by much, with which Reservoirs or Ponds are usually made, ought to be at least 3 Foot horizontal to one Foot perpendicular, that they may stand well, and not be apt to moulder : so that if a Reservoir be made 7 or 8 Foot deep, which ought to be done in Works of this Kind, the Basis of the Slope ought to be 28, 30 or 32 Feet ; the Profile or Section of which see *Fig. 2.* and the Banks ought to be cleared of all Trees and other Incumbrances which are apt to tear the Banks by their Rocking, by reason of the blowing of Winds.

The most proper Season for digging of Clay, and making Reservoirs, and other Waterworks of this kind, is generally reckoned to be about *Michaelmas*, after the Falling of the first Rains ; for then the Clay will work well ; and the cool Season is coming on, and in such Manner, that you may expect the Rains will fill your Work, in case a Supply should be precarious.

But the Winter or Spring, or indeed any other Part of the Year will do as well, provided

G g

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the Clay be used immediately after it has been digged ; and that you have a River, a strong Spring, or some good Engine to fill it ; but you must be sure to avoid Frosts, and the dry cutting Winds of *March*, which are more injurious to new Ponds, than any other Variation or Change of Weather does.

When the Shape of the Reservoir or Pond has been made, then the Clay is to be dug, and immediately used, otherwise you will be obliged to water it, which will spoil it ; also all large Stones, Sand Holes, and Veins should be carefully picked out ; and all such Parts as any way degenerate from the general M^{as}s or Vein of the Clay that is digged, should be thrown out.

The strong reddish or yellowish Clays are accounted the best, tho' there are also white and blue Clays, which are as tenacious as any of the rest ; tho' perhaps they are not so ductile, and do not work so well.

The Pond-men in the West-country chuse that Sort of Clay that has some small Quantities of small Pebbles or Gravel in it, because they say it rams better ; there is also this Convenience in them, that they lying upon the Chalk, will contract the Sediment and Slime, which comes with the Water, and render it more pure and clear.

Clays often run in Veins ; but if it be dug out of Pits, where it lies deep ; generally

the deeper you go, the better and stronger the Clay is.

Having found and dug a good Clay, carry it to the Place where it is to be used, and use it immediately, before it has been hardened by the Sun and Air, so that it won't work ; but if you have not immediate Occasion for it, cover it with long moist Horse-dung, or wet Hay or Thatch, and when it has been brought to the Place, where it is to be used, begin in the very Centre or Middle of the Bottom of the Pond, where it must be laid thicker than ordinary ; and then you must work every Way from it, treading and beating it well with Instruments, as you proceed : As to the Thickness of the Layer of Clay, there is no certain one agreed upon ; some laying it a Foot, others a Foot and a half, and some thicker ; and they lay it not all at once, but in two distinct Layers of about 6 or 8 Inches thick.

Having begun (as has been directed in the very Centre or Middle of the Reservoir, and laid it there about 6 or 8 Inches thick ; the Horse-heads or large Spits of Clay may be thrown together, just as they are dug out of the Pit, only picking out the large Stones, or any Veins of Sand that are in it, and work it well together with a large heavy Beater or Beetle, such an one as is used in cleaving of Wood.

Finish a Yard or two at a Time in this Manner ; which being done, you must use another Flat Beater, such as Greece,

is beaten with ; or rather (which is better) have one made in the Form of a hard Brush, where-with Maid-Servants rub their Rooms: but the Handle of it must be stronger, and in the Block there should be fix'd, 4, 5 or 6 strong Iron Teeth; which will cut or scratch cross the Joints, and prevent any open Chasm or Crack that would otherwise be there.

When this has been done, take such a Rammer as is us'd by Paviments (tho' it need not be quite so heavy) and smooth it over.

After you have done this, it will be proper to lay a little long Dung, Hay or Thatch on it, to keep the Clay from cracking till you lay on the second Coat.

Having thus finish'd the first Coat, after the Manner before directed, strew some slak'd Lime over it; which will not only corroborate and cause the Clay to grow hard and dry, and as it were, almost impenetrable; but it will also (as the West-Country Pond-makers say) hinder the Worms from working into the Clay.

Thus having finish'd the first Coat or Layer of Clay; begin the second of the same Thickness as you did the first, working it after the same Manner, every way from the Centre, taking Care especially to break, join or close the Clay well, by Means of your toothed or spiked Instrument before-mentioned; and there will be this Advantage in doing it over again, that if there should be

the least Crack or Perforation in the first Layer, the second coming over it, will fill it up, and mend every Place that may have happen'd to be defective.

Having finish'd the second Coat, as before, mix some Lime and Chalk together, and ram it on three or four Inches thick, which incorporating into the Clay, will render it as it were one solid Body, which, if there be Occasion, may be pitch'd with Flint Stones; that is, if Cattle are allow'd to go to it to drink.

All Reservoirs, if not wharf'd with Wood, Brick or Stone, (which is very expensive) ought to be pitched a Foot or two below the High-Water Mark, to prevent the Clay from being wash'd away on the Sides of the Reservoir; as also the working of Moles, Mice and other Vermin who spoil the Banks.

Some will lay a third Layer or Coat of Clay over the other two, and of the same Thickness, *viz.* six or eight Inches: This Method is not to be disapproved of (if Persons are willing to be at the Expence) and is also necessary in Grounds that are of a dry, gravelly, husky Nature; one of which Kind in *Essex*, the Water ran out so fast till the Earth was sated, that an Engine which was employ'd three Days and Nights could scarce keep it full; so that three times Claying is not much more expensive, but is very much securer.

The digging and claying of a Reservoir or Canal twice, is

said to be worth 12 *d.* a Yard superficial; and if it were to be clay'd a third time, it would not be above 3 *d.* a Yard more, but then all the Clay must be brought to the Place; but some Head West Country Pond-men have had 18 *d.* per Yard for twice claying.

It has been observ'd that the Pond-men in the West of *England*, do not pitch their Fish-Ponds so much as they were won't to do; but lay Chalk upon the Clay, six or eight Inches thick; which is better than pitching for all Sorts of Fish.

WATER WHEEL, an Engine for raising *Water* in great Quantity out of a deep *Well*.

It is of different Makes; some use a large one for Man or Beast to walk in for that Purpose, others a double Wheel with Logs, which makes it draw easier than the ordinary single Wheel; tho' this is not so good a way as the double Wheel with Lines; the Line at the Hand being small and very long: but there cannot be a more expeditious way than to make a larger Wheel at the End of the *Windlafs*, that may be two or three times the Diameter of the *Windlafs*, on which a smaller or a larger Rope may be wound, than that which raises the Bucket; so that when the Bucket is in the Well, the same Rope is all of it wound on the greater Wheel, the End of which may be taken on the Shoulder, and the Man may walk or run forwards, till the Bucket is drawn up;

in which Operation the Bucket may hold 20 or 30 Gallons, and yet be drawn up with more Ease than one of seven or eight in the ordinary way; and besides the Bucket may have a round Hole in the Bottom, with a Cover fitted to it like the Sucker of a Pump, that when the Bucket rests on the Water, the Hole may open and the Bucket fill, and as soon as it is rais'd, the Cover stops it immediately, which prevents it from diving.

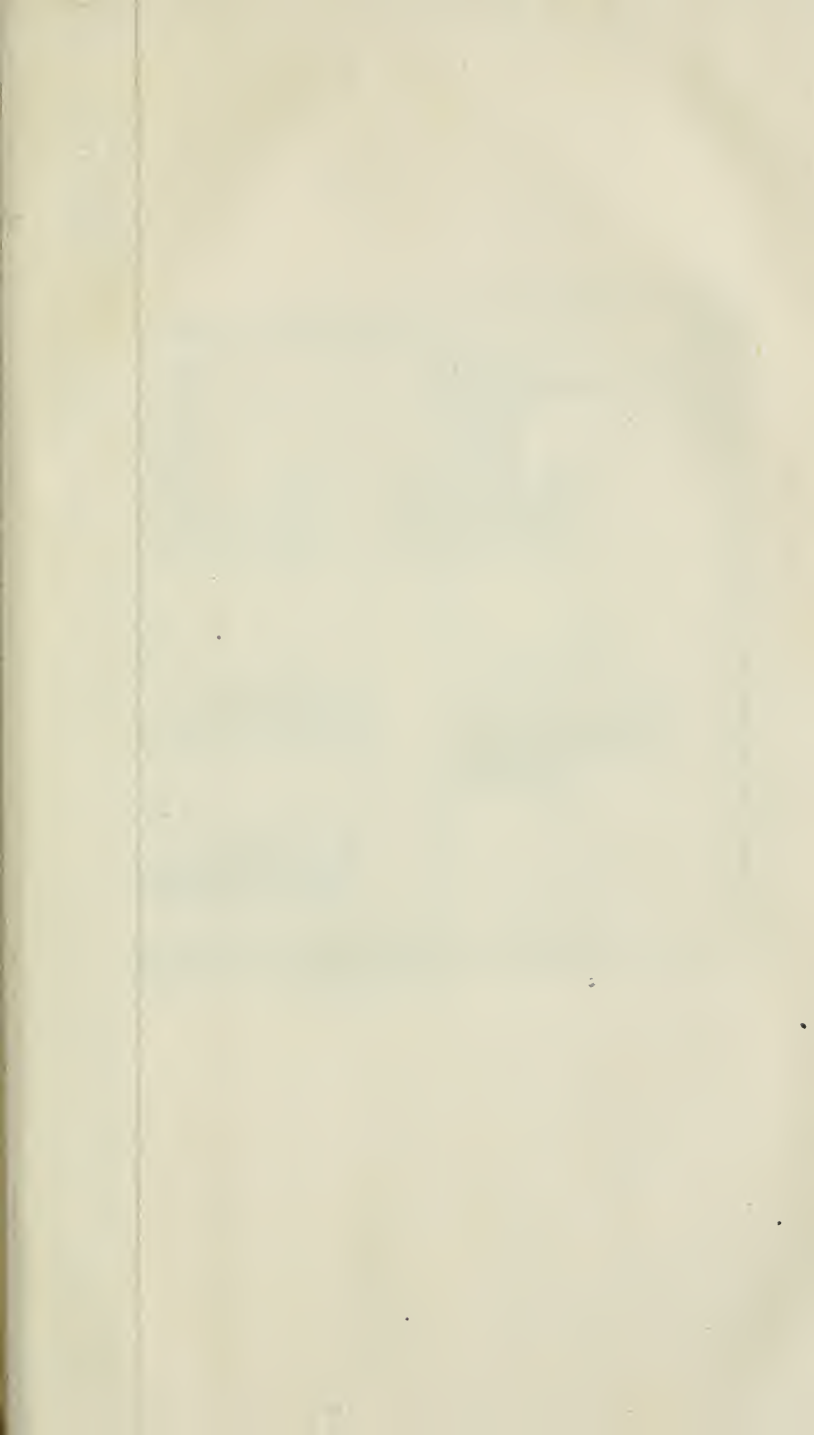
Teeth may also be made on the outer Wheel, with a wooden Ledge, so falling upon it, that as the Man moves forward, it may stop; but when the Bucket is as high as is intended, then the Ledge bearing against the Teeth, stops the Bucket until you come to it, after the Manner of the Wheel of a *Watch*, *Clock* or *Jack*.

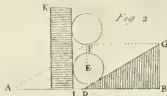
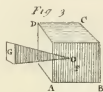
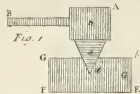
To which may be added, that when the Bucket is up, a Receiver may be at Hand, and a moveable Trough to slip under the Bucket; that when the Cover is rais'd by a small Cord, fastened to it on the Inside, the Water may be receiv'd thereby: by this Means many Tuns of Water may be drawn up in a short Time.

WEATHER BOARDING [in *Carpentry*] signifies the nailing up of Boards against a Wall.

Sometimes 'tis us'd to signify the Boards themselves, when nail'd up.

This Work is usually done with Feather-edg'd Boards: In plain Work they usually nail the





the thick Edge of one Board, an Inch or an Inch and a half over the thin Edge of another; but if the Work is to be something extraordinary; they set an O G on the thick Edge of every Board.

The Price] The Price of Plain Weather Boarding (*viz.* the fitting and nailing up the Boards) is from 8 *d.* to 12 *d.* the Square, according to the Length and Breadth of the Boards, and Conveniency of the Place.

But if the lower, (*viz.* the thicker) Edge of the Boards be wrought with an O G it may be worth 18 *d.* per Square, for the Workmanship only.

If the Workman find the Materials (*i.e.* Boards and Nails) it may be worth 12 or 13 *s.* per Square, or about 1 *d.* $\frac{1}{2}$ per Foot.

WEATHER TILEING is the covering the upright Sides of Houses with Tiles.

The Price.] Weather Tileing is done in some Places at the same Price as other Plain Tileing; but in other Places they have more in Consideration of Scaffolding: for some Workmen say they have 4 *s.* per Square for Workmanship only.

WEDGE. The Power of this Engine is put in Motion by Percussion or striking; it is therefore to be first observ'd That the Centre of Percussion is that Point by which a Body, as a Beetle, &c. in its Motion strikes with its greater Force another Body (as a Wedge) which opposes its Motion.

That is, the Point A in the middle of the Wedge A D,

just under the Centre of Gravity N, of the Beetle B A is the Centre of Percussion, and the Line N A is its Line of Direction. See *Plate, Fig. 1.*

And it is to be observ'd here, as before, in the preceeding Machines, that the greatest Force or Blow is given, when it falls perpendicularly upon the Wedge; on which the Stroke or Force is apply'd; for 'tis evident, that if the Stroke or Force is applied at oblique Angles, as the Beetle E F, the Line of Direction of the Force N B, will not be parallel to the Central Line of the Wedge A I; nor will the Line of Direction of the Force E N, be parallel to the upper Surface of the Wedge, as in the former.

Now, seeing that the Line of Direction N B is contrary to the Line of Direction N A D, 'tis evident that the Beetle F E apply'd at oblique Angles, has less Force on the Wedge I, than when apply'd at Right Angles, as the Beetle B A on the Wedge C.

To understand the Power of the Wedge, one of the inclining Sides is to be considered as a horizontal Plain, and we must imagine, that by the Help of the inclin'd Surface, a Power shall raise a Weight, which without this Machine, could not so much as sustain or bear it up.

1. Let the Triangle D B C, right-angled at B, represent a Wedge, wherein let the angular Point D, represent the Point or Edge, and the Perpendicular

BC, the Head at which the Power is to be apply'd.

For the better understanding the Power of this Engine, the Length of its Base, as DB, and Height BC must be given or known, that thereby their Proportions to one another, may be known. See *Plate, Fig. 2.*

For the Analogy or Proportion is this :

As the Height of the Wedge
Is to the Base of the Wedge,

So is the Power apply'd at
its Centre of Percussion, to the
Weight that the Wedge will
sustain or bear up.

Which will immediately be demonstrated ; but 'tis to be noted, that in all Calculations of this Kind, the Surfaces of the horizontal Plane, whereon the Wedge slides, the Surfaces of the Wedge, the Surface of the Body to be rais'd, are suppos'd to be so very smooth, as to slide without Obstruction or Difficulty.

Again it must also be suppos'd, that the Weight E be hindred from going to A, by the perpendicular Plane HIK ; which however is to be suppos'd not to hinder the Wedge DCB from sliding along the horizontal Plane AB, as 'tis driven or forc'd from B towards the Power apply'd at B, whose Line of Direction is parallel to the Horizon.

Now if the Power apply'd at B, drives or forces the Wedge CDB regularly from B towards A, upon the horizontal Plane AB, it will cause the Weight E to ascend by so regular a Motion, that its Centre of Gravity E will by its Ascension gene-

rate the Right-Line FD, perpendicular to the Horizon ; so that when the Point B shall be come to D, the Point C to E, and the Point D to G, the whole Wedge CDB shall have chang'd its Place to EDG, and the Body E will be rais'd the whole Height of CB, the perpendicular Height of the Wedge.

Now if BB the Base, be = twice BC the Height, then the Power shall have mov'd the Line DB its whole Length, which is = twice CB, and therefore the Power to the Weight will be, as 1 is to 2 : That is,

As the Height CB 1,

Is to the Base DB 2 :

So is the Power of one Pound apply'd by Percussion at B, to two Pound, the Weight of the Body E, rais'd to F.

From hence it follows, that the more acute the Wedge is, the greater will its Effect be : because GD the Velocity of the Power, will be great in Comparison of DF, the Velocity of the Weight.

When the Wedge is apply'd to cleave a Body, as ABCD, the Planes EFOI and GFOH, which make up the Wedge, being more inclin'd to each other, the Parts EG will therefore slide more easily.

If the Plane EFOI be considered as a horizontal Plane, the other Plane GFOH will be an inclining Plane ; wherefore the Resistance of the upper Part of the Body ABCD, which is to be disunitied from the lower, may be accounted as a Weight whose Line of Direction

rection is perpendicular to the lower or horizontal Part, and then a Power apply'd as afore-said with an additional Power for the Roughness of the Body, when irregular will have the Effect desired. See *Plate, Fig. 4.*

It is also to be observ'd, that altho' the Power of a Blow or Stroke, is equal to a certain Weight, yet if that Weight is laid gently upon a Wedge, it will not have the same Effect in forcing it into a hard Body, as when the same Weight is communicated to it by a Blow.

And it is also to be observ'd, that the Effect of Percussion will be the greater in Proportion as the Percutient or striking Body is heavier and swifter: that is to say, the heavier the Body is, with which the Stroke is given, the greater Effect it will have.

Therefore,

If with a Body of ten Pound Weight, a Stroke be given in one Second of Time, that will raise 20 Pound Weight, the same Body being struck in like Manner, will double the Force; that is, in half a Second of Time, it will raise 40 Pound Weight, which is double to the former.

Hence it appears, that the Power of Percussion is proportionable to the Velocity of the Stroke.

If any shall object that they do not conceive how the Wedge is of any great Use in raising heavy Bodies, since there seems to be a resisting Plane necessary as *K H I*, which in many

Cases cannot be practicable, and therefore of Consequence, the Wedge seems to be of little Use.

But such Persons are mistaken; for an heavy Body may be rais'd without a Plane perpendicular to resist it.

As for Example, Suppose the Body *E* is to be rais'd to the Height of the Wedge *F G*, it is plain that if against the Wedge *F D G*, you place another Wedge, as *A B D* equal thereto, so as to work close to each others Sides, and each Wedge being driven with equal Force, will raise the Body *E* the Height required. See *Plate, Fig. 4.*

And as has been said before, the longer or more acute the Angle of the Wedge is, the easier the Weight will be rais'd. This has been already prov'd, and therefore I shall not repeat it.

It is likewise to be observ'd in this, as has been observ'd of other Mechanical Powers; that as much as is gain'd in Force, is lost in Space and Time, because the more acute a Wedge is made, the greater Length it must be to be equal in Height to another Wedge, whose Angle is less acute, or rather, whose Angle contains a greater Number of Degrees.

That is, the Wedge *A C D*, whose Line *A D C* is less than the Line *B D E*, must be longer than the Wedge *B D E*, to be equal in Height thereto, for was the Wedge *A D C* to be no longer than the Wedge *B D E*, that is, *G F D E*, then it could

not raise the Body higher than F. See *Plate, Fig. 5.*

Hence 'tis evident that DF must be continued to A, and DG to C, whereby it will raise the Body to the Height requir'd.

And since that tho' the Wedge ADC will move with less Force than the Wedge BDE, yet it requires more time, because its Length CD is greater than DE.

Therefore it is plain, that what is got in Force, is lost in Space, as has been already prov'd in other Engines.

WEIGHT is a Quality in natural Bodies, whereby they tend downwards, towards the Centre of the Earth.

Or *Weight* may be defin'd to be a Power inherent in all Bodies, whereby they tend to some common Point, call'd the Centre of *Weight* or *Gravity*; and that with a greater or less Velocity, as they are more or less *dense*, or as the Medium they pass thro' is more or less rare.

But there may yet be another Definition. As in Effect one may conceive *Gravity* to be the *Quality*, as inherent in the Body; and *Weight* the same Quality exerting it self, either against an Obstacle or otherwise.

Hence Weight may be distinguish'd like Gravity into *absolute* and *specifick*.

Sir I. Newton demonstrates, that the *Weights* of all Bodies, at equal Distances from the Centre of the Earth, are proportionable to the Quantity of Matter that each contains.

Whence it follows, that the *Weights* of Bodies have not any Dependance on their Forms or Textures; and that all Spaces are not equally full of Matter.

Hence it follows, that the *Weights* of the same Body, is different on the Surface of different Parts of the Earth; by Reason that its Figure is not a Sphere, but a Spheroid.

The Law of this Difference the Author gives in the following Theorem.—The Increase of Weight as you proceed from the Equator to the Poles, is nearly of the versed Sine of double the Latitude; or which amounts to the same: as the Square of the Right Sine of the Latitude.

WEIGHT [in *Mechanicks*] is any Thing that is to be rais'd sustain'd or mov'd by a Machine; or any Thing that in any Manner resists the Motion to be produc'd.

In all Machines there is a natural Ratio between the *Weight* and the moving Power. — If the Weight be increas'd, so must the Power too; that is, the Wheels, &c. are to be multiply'd, and so the Time increas'd, or the Velocity diminish'd.

WELDING Heat [in *Smithery*] a Degree of Heat which Smiths give their Iron in the Forge; when there is Occasion to double up the Iron, and to weld a work in the doublings; so that the Iron shall grow into a Lump, thick enough for the Purpose.

WELL [in *Building*] is a Hole

Hole left in the Floor for the Stairs to come up thro'.

WELL, a narrow Opening of a cylindrical Form, made by digging in the Earth: Wells where they are not natural, are principally made, in order to have Water in those Places where it is wanted.

In digging for a Well, you must do it in a Place remote from Houses of Offices, Stables, Dunghills, and other Places, which by their Stench may impart a very disagreeable Taste to the Water: as for the Goodness of the Water, that depends upon the Nature of the Place where the Well is digged; for if the Earth be sandy or black, or inclines to a Potters Clay, and white, slimy Soil, or to speak more properly, if it has Flint and Sand together, then there is no doubt to be made but that the Water will be very good.

On the contrary, if it be spungy, or has Chalk or Mud therein, it will not answer the Purpose; and happy are they who have Grounds endued with those Qualities that are necessary for yielding good Water; otherwise there is no Remedy.

There are several Persons who have Houses near Meadows, and have a mind to dig for Wells, believing they may save Money by making them in such Places, and observing those where Willows are planted, or else, where Reeds grow, whose Nature has an entire Tendency to Moisture; they fix their Plan immediately there, and

fancy a Well dug at such a Place and with a small Expence, cannot but be lasting; but they are much mistaken, for tho' these Places are very moist, yet the Wells that are made there, are much more subject to dry up than others; and the Water is generally good for nothing.

Wells must be always kept in Repair, the Labour is not great; and no further Care is to be had, than to cleanse them once a Year, and that no Filth of any Kind be thrown into them.

But in Opposition to the Opinion of those who keep their Well covered in order to preserve them clean, it may be affirm'd, that they cannot be kept too open, that the Air may have a free Passage, which subtilizes the Nature of the Water, and makes it much purer than otherwise it would be without this Help.

If you would drink good Well Water, you must draw it often; for it is most certain, that the oftener Water is drawn, the less gross the Parts will be that compose it; and consequently it will be more conducive to your Health.

If you would have Wells near the Sea, with fresh Water, dig a good large Ditch or Pit, as of about 100 Foot Diameter; having first planted very long Stakes or Piles, cleanse it well, throw out the Mud; besides these Stakes, by the Help of which you defend it against the Tide; and when the Pit is dry, and that there is no wet in it,
you

are to fix another Row of very long Piles, about ten Foot distant from the first, and likewise throw out the Mud, and this should be done three or four times, till you come at fresh Water.

When by any of the before-mention'd Trials in the Article *Water*, a Place has been pitch'd upon that is proper to bore, you must provide your self with a large Augar, that may be grafted at every five or six Foot; and having made a Hole in the Top of the Ground, where you intend to bore, about three or four Foot wide, or more, to give Room for the Workmen to make the Experiment the better, then you may proceed; and when you have bor'd one Length of the Augar of four or five Foot, as aforesaid, then graft on another Length, and so on, till you come down to the Water, ever and anon pulling out your Augar and cleansing it, to examine what Soil you bore through.

When you dig for a Well, great Care ought to be taken, not only in stewing the Sides, to keep the Earth from falling in upon the Workmen; but to take Care that the Effluvias of the Water (which if bad) do not hurt them; for it has been often found, that the Water which is under the Earth, hath many bad Qualities, and emits Vapours, which often stifle those that work in the Well after it has been dug.

To prevent which, the Ancients (as *Vitruvius* has it)

were wont to let a Lamp gently down into it, and if it extinguish'd it, they took it for an infallible Sign that the Water was bad.

WHEEL [in *Mechanicks*] is a simple Machine, consisting of a round Piece of Wood, Metal or other Matter; turning round on an Axis.

The *Wheel* is one of the principal *Mechanick* Powers, it has Place in most Engines; and indeed 'tis of an Assemblage of *Wheels* that most of our chief Machines are compos'd, as Mills, &c.

Its Form is various, according to the Motion it is to have, and the Use it is to answer, and is accordingly distinguish'd into *simple* and *dented*.

Simple Wheels are such whose Circumference and Axis is uniform, and which are us'd singly, and without a Combination.

Such are the *Wheels* of Carriages which are to have a double Motion; the one circular about their Axis; and the other rectilineal; by which they advance along the Road, &c. which two Motions they appear to have, tho' in Reality they have but one; it being impossible that the same Thing should move or be agitated two different ways at the same time.

This one is a spiral Motion, as is easily seen by fixing a Piece of Chalk on the Face of a *Wheel*, so as it may draw a Line on a Wall, as the *Wheel* moves.

The Line it here traces, is a just

just Spiral, and still the more curve as the Chalk is fix'd nearer the Axis.

In Wheels of this Kind, the Height ought to be always proportioned to the Nature of the Animal that draws or moves them.

The Rule is, that the Axis and Load of the Wheel be of the same Height, with the Force that moves them; or else the Axis being higher than the Beast, Part of the Load will lie on him; or if it be lower, he will pull at a Disadvantage, and must exert a greater Force.

Dr. Wallis and others have shewn, that to draw a Vehicle, &c. over waste uneven Places, it will be best to fix the Traces to the Wheels lower than the Horse's Breast.

The Power of these Wheels results from the Difference of the Radii of the Axis and Circumference.

The Canon is this: As the Radius of the Axis is to that of the Circumference, so is any Power to the Weight it can sustain hereby.

This is also the Rule in the Axis in *Peritrochio*; and the Wheel and the Axis in *Peritrochio*, See *Plate, Fig. 6.* are in effect, the same Thing; only in Theory it is usually called by the former Name, and in Practice by the latter.

Dented Wheels are those whose Circumference, or else Axis, is cut in Teeth, by which they are rendred capable of moving and acting one on another, and of being combined together.

The Power of dented Wheels depends on the same Principle, as that of the simple one. The Difference is only that to the simple Axis in *Peritrochio*, which a compound Lever is to a simple one.

Its Doctrine is comprised in the following Canon, *viz. The Ratio of the Power to the Weight, in order for that to be equivalent to this, must be a Ratio compounded of the Ratios of the Diameter of the Axis of the last Wheel, to the Diameter of the first, and of the Ratio of the Revolutions of the last Wheel, to those of the first in the same Time.*

But this Doctrine will deserve a more particular Explanation.

1. Then if the Weight be multiplied into the Product of the Radii of the Axis, and that Product be divided by the Product of the Radii of the Wheels, the Power required to sustain the Weight will be found.

2. If the Power be multiplied into the Product of the Radii of the Wheels, and the *Factum* be divided by the Product of the Radii of the Axis; the Quotient will be the Weight which the Power is able to sustain: thus if the Power be $22\frac{1}{2}$ of a Pound, the Weight will be 6000 Pounds.

3. *A Power and a Weight being given to find the Number of Wheels, and in each Wheel, the Ratio of the Radius of the Axis to the Radius of the Wheel: So as that the Power being applied perpendicularly to the Periphery of the last Wheel,*

Wheel, may sustain the given Weight.

Divide the Weight by the Power : Resolve the Quotient into the *Factors* which produce it, then will the Number of *Factors* be the Number of *Wheels* ; and the *Radii* of the Axis will be to the *Radii* of the *Wheels*, as *Unity* is to the several *Wheels*.

As suppose for Example, a Weight of 3000 Pound, and a Power of 60, which resolves into these *Factors* 4,555 Four *Wheels* are to be made, in one of which the Radius of the Axis is to the Radius of the Wheel, as 1 to 4. In the rest, as 1 to 5.

4. If a Power move a Weight by the means of two *Wheels*, the Revolutions of the slower Wheel, are to those of the swifter, as the Periphery of the swifter Axis is to the Periphery of the Wheel which catches on it.

5. If a Power move a Weight by means of divers *Wheels*, the Space pass'd over by the Weight is to the Space of the Power, as the Power is to the Weight. Hence it follows, that the greater the Power is, the faster will the Weight be moved, and *vice versa*.

6. The Spaces pass'd over by the Weight and the Power, are in a *Ratio* compounded of the Revolutions of the slowest Wheel, to the Revolutions of the swiftest ; and of the Periphery of the Axis of that, to the Periphery of this.

Hence, since the Space of the Weight and the Power, are reciprocally as the sustaining

Power to the Weight ; the Power that sustains a Weight, will be to the Weight, in a *Ratio* compounded of the Revolutions of the slowest Wheel, to those of the swiftest, and of the Periphery of the Axis of that, to the Periphery of this.

7. *The Periphery of the Axis of the slowest Wheel, with the Periphery of the swiftest Wheel given ; as also the Ratio of the Revolution of the one to those of the other, to find the Space which the Power is to pass over, while the Weight goes any given Length.*

Multiply the Periphery of the Axis of the slowest Wheel into the antecedent Term of the *Ratio*, and the Periphery of the swiftest Wheel into the consequent Term ; and to these two Products ; and the given Space of the Weight, find a fourth Proportional : This will be the Space of the Power.

Suppose, for Example, the *Ratio* of the Revolutions of the slowest Wheel, to these of the swiftest, to be as 2 to 7 ; and the Space of the Weight 30 Feet : and let the Periphery of the Axis of the slowest Wheel be to that of the swiftest, as 3 to 8, the Space of the Power will be found to be 280.

8. *The Ratio of the Peripheries of the swiftest Wheel, and of the Axis of the slowest ; together with the Ratio of their Revolutions, and the Weight being given, to find the Power able to sustain it.*

Multiply both the Antecedents and the Consequents of the given *Ratio* into each other, and

and to the Product of the Antecedents, the Product of the Consequents, and the given Weight, find a fourth Proportional, and that will be the Power required.

As suppose, for Example, the *Ratio* of the Peripheries $8 : 13$ that of the Revolutions $7 : 2$, and the Weight 2000 , the Power will be found $214 \frac{2}{7}$. After the same Manner may the Weight be found; the Power and the *Ratio* of the Peripheries, &c. being given.

9. *The Revolutions the swiftest Wheel is to perform, while the slowest makes one Revolution, being given; together with the Space, the Weight which is to be rais'd, and the Periphery of the slowest Wheel; to find the Time that will be spent in raising it.*

Say, as the Periphery of the Axis of the slowest Wheel is to the Space of the Weight given; so is the given Number of Revolutions of the swiftest Wheel to a fourth Proportional, which will be the Number of Revolutions performed, while the Weight reaches the given Height.

Then by Experiment determine the Number of Revolutions the swiftest Wheel performs in an Hour; and by this divide the fourth Proportional found before, the Quotient will be the Time spent in raising the Weight.

The Power of the Wheel by its Axle.

This Engine is of great use at

the several Keys and Wharfs of *London*, in raising and taking up all manner of Goods of Burden, at their Loading and Unloading in and out of Ships, &c. where the Power applied is the Weight of Men who walk within the Wheel, and thereby raise the Weight required. See *Plate, Fig. 4.*

If you observe this Machine, and consider the Radius $A O$ of the Wheel $A B C D$, with the Radius $O G$ of the Axis, which move on their Centre O , it is plain, that it is nothing but a *Lever* of the first kind perpetually turned round; for $A O$ is the Distance of the Power, $O G$, the Distance of the Weight, and the Centre O the *Fulcrum*. And therefore,¹

If a Weight is raised by Means of such a Wheel, with its Axle moving round its Centre, by a Power whose Line of Direction touches the Circumference of the said Wheel, the Power will be to the Weight, as the Radius of the Axle is to the Radius of the Wheel.

Suppose the Weight E in the Figure is raised by means of the Wheel $A B C D$, with its Axle $E O G$ moving round the Centre O , by a Power Z , whose Line of Direction $Z A$ touches the Circumference of the Wheel, as a Tangent raised from the Point A of the Radius $A O$; the Power A will be to the Weight I , as the Radius of the Wheel $A O$, is to the Radius $O G$ of the Axle.

Let the Radius $A O$ be $= 10$ Feet, the Radius $O G = 1$ Foot, and the Power applied at A

A = 15 Pound Averdupois ;
then I say,

As the Radius of the Axle
1 Foot,

Is to the Radius of the Wheel
10 Feet,

So is 15 the Power applied
to 150, the Weight at I, which
is the Equipoise of the Power
A required.

Again the Weight being giv-
en to find the Power.

As the Radius of the Wheel
10 Feet,

Is to the Radius of the Axle
1 Foot,

So is 150 the Weight given,
to 15 the Power required.

The O P E R A T I O N S.

1	:	10	::	15	:	150		10	:	1	:	150	:	15
				10								1		
				<hr/>								<hr/>		
				1)150(150								10)150(15		

From these Operations, 'tis plain, that as much as the Radius of the Wheel is greater than the Radius of the Axle, so much is the Power of the Force increased, always supposing the Line of Direction of the Power to touch the Circumference of the Wheel, as A Z, whereby the Line O A Z will always be the same, and a right Angle to whatever Point of the Circumference is applied; for were the Line of Direction otherwise applied, this would not hold. As for Instance.

Suppose the Power were applied at L, and its Line of Direction L K perpendicular to Horizon, then it is evident, that the Distance of the Power from the *Fulcrum*, would be but = K O; and since that K O is less than A O, it is plain that the Power is thereby diminished, and made less than when applied at A as aforesaid.

It being thus demonstrated, that the Power of the Wheel

and Axle is gain'd by the Difference of their respective Radius, it appears to be with this as with the other mechanical Powers, that whatever is gained in Force, is lost in Time and Space.

This is very easily understood; for as the Radius of the Axle makes but one Revolution in the same Time that the Radius of the Wheel makes one Revolution, 'tis evident, that the Circumference of the Wheel, which is greater than the Circumference of the Axle, must move with greater Force, and that proportionably to the Difference of their Radius.

In this Example, the Circumference of the Axle is = $3\frac{1}{2}$ nearly, and the Circumference of the Wheel = $31\frac{1}{2}$ nearly.

Now, if $31\frac{1}{2}$ be divided by $3\frac{1}{2}$ nearly, the Quotient is = 10; that is, the Circumference of the Axle is contained 10 Times in the Circumference of the

the Wheel ; wherefore the Wheel to raise the Weight one Foot in Height, must pass thro' a Space of 10 Feet ; so that what it will have gain'd in Force, will be lost in Space, according to the Difference of the Radius, which is as 1 is to 10. Q E D.

WHISPERING Places depend on this Principle, that the Voice being applied to one End of an Arch, easily rolls to the other. Accordingly all the Contrivance of a whispering Place, is, that near the Person who whispers, there be a smooth Wall arch'd, either cylindrically or elliptically. A circular Arch will do, but not so well.

The most remarkable Places formed for the Conveyance of Whispers, are the Prison of *Dionysius* at *Syracuse*, which creates a soft Whisper to a Noise ; the Clap of one's Hand, to the Sound of a Canon, &c.

The Aqueducts of *Claudius*, which are said to carry a Voice 16 Miles ; and divers others, which *Kircher* mentions in his *Phonurgia*.

The most considerable Whispering Place in *England* is the Dome of *St. Pauls* in *London*, where the Ticking of a Watch may be heard from Side to Side, and a very easy Whisper be sent all round the Dome.

This Mr. *Derham* discovered to hold not only in the Gallery below, but above upon the Scaffold, where a Whisper would be carried over ones Head, round the Top of the Arch, tho' there is a large Opening in the Middle of it, into the upper Part of the Dome.

The famous Whispering Place in *Gloucester* Cathedral, is no other than a Gallery above the East-end of the Choir, leading from one Side of it to the other.

It consists of five Angles and six Sides, the Middlemost of which is a naked Window ; yet two Whisperers hear each other at the Distance of 25 Yards.

WHITE LEAD is the Rust of Lead, or Lead dissolved by Vinegar, much used by Painters.

There are two ways of preparing it. 1. Either by reducing the Lead into thin *Lamine*, steeping them in strong Vinegar, and every 10 Days scraping off the Rust form'd on the Surface : and repeating this till the Lead is quite consumed.

2. Or by rolling the *Lamine* into Cylinders, like Sheets of Paper, only so as there be a little Space left between the several Folds or Turns.

These *Lamine* are suspended in the Middle of earthen Pots, at the Bottom of which is Vinegar.

These Pots being well closed, are buried in a Dunghill for 30 Days ; after which, being opened, the Lead is found as it were calcined, and reduced into what they call White Lead, to be broken into Pieces, and dried in the Sun.

White Lead is used both in Painting in Oil and Water Colours, and makes a beautiful Colour in each ; but it is something dangerous both in grinding

ing and using it, as being a rank Poison.

WICKET is a little Door within a Gate, or a Hole in a Door, thro' which to view what passes without.

WIND-BEAM. See *Collar-Beam*.

WINDLASS is a Machine

WINDLESS used for raising huge Weights withal, as Stones, &c.

It is very simple, consisting only of three Pieces of Wood, a Roll or Axle-tree, and a Pulley. The Pieces of Wood meet at Top; being placed diagonally, so as to prop each other. The Axis or Roller goes thro' two of the Pieces, and turns them. The Pulley is fastened at Top where the three Pieces join.

There are two Levers go thro' the Roll, by which it is turned, and the Rope which comes over the Pulley is wound off and on the same.

WIND-MILL is a Kind of Mill which receives its Motion from the Impulse of the Wind.

The Wind-mill, altho' it is a very common Machine, has nevertheless somewhat in it more ingenious than is commonly imagined.

And it is allowed to have a Degree of Perfection, which few of the popular Engines have attained to, and which the Makers themselves are very little aware of.

The Structure of a Wind-mill.

The internal Structure of the Wind-mill is much the same as

that of Water Mills. The Difference between them lies chiefly in an external *Apparatus* for the Application of Power. See *Plate, Fig. 5.*

This *Apparatus* consists of an Axis, through which pass two Rods or Yards, and intersecting each other at right Angles, whose Length is usually about 32 Feet.

On these Rods are formed a Kind of Sails, Vanes, or Flights, in the Figure of *Trapeziums*, with parallel Bases, the greater of which is about 6 Feet, and the left determined by *Radii* drawn from the Center.

These Sails are to be capable of being always turned to the Wind, that they may receive its Impulse: in order to which, there are two different Contrivances, which constitute the two different Kind of Wind-mills.

In the one, the whole Machine is sustained upon a moveable *Arbor* or Axis, perpendicular to the Horizon, on a Stand or Foot; and turned occasionally this way or that, by means of a Lever.

In the ether, only the Cover or Roof of the Machine, with the Axis and Sails turn round; in order to which the Cover is built Turret-wise, the Turret being encompass'd with a Wooden Ring, in which is a Groove, at the Bottom of which a Number of Brass Truckles are placed at certain Distances, and within this Groove is another Ring, upon which the whole Turret stands.

To the moveable Ring is connected Beams, and to the Beam



Fig. 1.

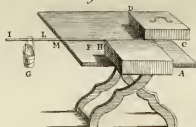


Fig. 2.

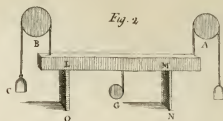


Fig. 4.

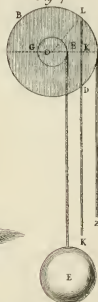


Fig. 6.

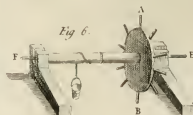


Fig. 3.

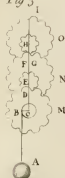
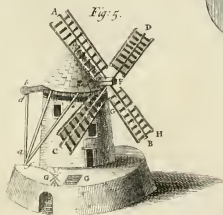


Fig. 5.



Beam is fastened a Rope, which at the other Extreme of it, is fitted to a Windlass or Axis in *Peritrochio*: This Rope being drawn through an Iron-Hook, and the Windlass turn'd the Sails will be moved round, and put in the Direction required.

The Theory of the Motion of a Wind-mill, with the Position of its Vanes and Sails.

The Angle which the Sails are to make with their common Axis, so that the Wind may have the greatest Effect, is a Matter of nice Enquiry, and has employed the Thoughts of Mathematicians.

The Theory of compound Motion must be supposed in order, to conceive why a Wind-mill moves at all. A Body that moves perpendicularly against any Surface, strikes it with all its Force. If it move parallel to the Surface, it does not strike it all; and if it move obliquely, its Motion being compounded of the perpendicular and the parallel Motion, only acts on the Surface, considered as it is perpendicular, and only drives it into the Direction of the Perpendicular.

So that every oblique Direction of a Motion is the Diagonal of a Parallelogram, whose perpendicular and parallel Directions are the two Sides.

Add to this, that if a Surface which being struck obliquely, has only received the perpendicular Direction, be fastened to some other Body, so that it can-

not pursue its perpendicular Direction, but must change it for some other; in that Case, the Perpendicular it self becomes the Diagonal of a new Parallelogram, one of whose Sides is the Direction, the Surface may follow, and the other, that it cannot.

Thus a Rudder fastened obliquely to the Keel of a Vessel, being struck by the Current of Water parallel to the Keel, and of Consequence obliquely with respect to it self, it will appear by drawing the Line of perpendicular Impulse, that it tends to tear the Rudder from the Keel, and to carry it away: and that this Direction perpendicular to the Rudder is oblique to the Keel.

The Rudder then would be carried off in an oblique Direction; but as in Effect it is so secured, that it cannot be torn or carried off, we are only to consider in this compound Motion, that of the two Directions, wherewith it can move without being torn from the Keel, and leave the other, which would tear it off, as useless.

Now the Direction in which it can move, without parting from the Keel, is that which carries it circularly about its Extremity, as a Centre.

So that the Effect of the oblique Impulse of the Water on the Rudder, is reduced, first to a perpendicular Impression, which is again reduced to the mere turning the Rudder round; or if the Rudder be immovable, to the turning of the Vessel.

Now in an oblique and compound Motion, where only one of the Directions is of Service, the greater *Ratio* the other has to it, the less Effect will the Motion have, and *vice versa*.

In examining the compound Motions of the Rudder, we find, that by how much the more oblique it is to the Keel, the *Ratio* of Direction which serves to turn it to the other, is the greater.

But on the other Hand, by how much the more oblique it is to the Keel, and consequently to the Course of the Water, which is supposed parallel to it, it will strike by so much the more weakly.

The Obliquity of the Rudder therefore has, at the same Time, both an Advantage and Disadvantage; but as those are not equal, and as each of them are still varying, with every different Position of the Rudder, they become variously complicated; so that sometimes the one prevails, and sometimes the other.

It has been the Subject of Enquiry, to find the Position of the Rudder, wherein the Advantage should be the greatest. Mr. *Renau*, in his famous Theory for the working of Ships, has found, that the best Situation of the Rudder, is when it makes an Angle of 55 Degrees with the Keel.

If now a Wind-mill exposed directly to the Wind, should have its four Sides perpendicular to the common Axis wherein they are fitted; they would receive the Wind perpendicu-

larly, and it is visible that Impulse would only tend to overturn them.

There is a Necessity therefore to have them oblique to the common Axis, that they may receive the Wind obliquely.

For the more easily conceiving, let us only consider one vertical Sail. The oblique Impulse of the Wind on this Sail is reducible to a perpendicular Impulse; and that Direction, as the Sail cannot absolutely keep to it, is compounded of two; one of which tends to make it turn on its Axis, and the other to fall backwards.

But it is only the first of these Directions can be obeyed, and consequently the whole Impulse of the Wind on the Sail, has no other Effect, but to make it turn from Right to Left, or from Left to Right as its acute Angle turns this way or that. And the Structure of the Machine is so happy, that the three other Sails are determined, from the same Reasons, to move the same Way.

The Obliquity of the Sails with respect to their Axis, has exactly the same Advantage and Disadvantage with the Obliquity of the Rudder to the Keel. And M. *Parent* seeking by the new Analysis, the most advantageous Situation of the Sails on the Axis, finds it precisely the same Angle of 55 Degrees; yet this Rule is very little observed in Practice, as, indeed, being but little known. They are usually made about 60 Degrees, which is very much out of the way.

An Elliptical Wind-mill.

M. Parent has considered further, what Figure the Sails of a Wind-mill shall have, so as to receive the greatest Impulse of the Wind; and he determines it to be a Sector of an Ellipsis, whose Center is that of the Axis or *Arbor* of the Mill, and the little Semi-Axis the Height of 32 Feet. As for the greater, it follows necessarily, from the Rule that directs the Sail, to be inclined to the Axis 55 Degrees.

On this Foot he assumes 4 such Sails, each of which is $\frac{1}{4}$ of an Ellipsis; which he shews will receive all the Wind, and lose none, as the common ones do. These four Surfaces multiplied by the Lever with which the Wind acts on one of them, express the whole Force the Wind has to move the Machine, or the whole Force the Machine has when in Motion.

The same Manner of reasoning applied to a common Wind-mill, whose Sails are rectangular, and their Height about 5 Times their Breadth; shows that the Elliptical Wind-mill has above 7 Times the Force of the common ones, which is a prodigious Advantage; and therefore certainly deserves to have the common Practice set aside, if so common a Practice could be easily changed.

He shews, that a Wind-mill with six elliptical Sails, would still have more Force than one with four.

It would only have the same Surface with the 4; since the

four contain the whole Space of the Ellipsis as well as the 6.

But the Force of the six would be more than that of the four, in the *Ratio* of 245 to 231.

If it were desired to have only two Sails, each being a Semi-ellipsis, the Surface would be still the same; but the Force would be diminished by near $\frac{1}{3}$ of that with six Sails; by reason the greatness of the Sectors would much shorten the Lever with which the Wind acts.

The best Form and Proportion of Rectangular Wind-mills.

But as elliptical Sails would be something so new, that there is little reason to expect they will come into common use; the same Author has consider'd which Form among the Rectangular ones will be the most advantageous, *i. e.* which the Product of whose Surface, by the Lever of the Wind, will be the greatest.

And by the Method, *De maximis et minimis*, he finds it very different from the common ones.

The Result of this Enquiry is, that the Width of the Rectangular Sail, should be nearly double its Height or Length, whereas the Height or Length are usually made almost five Times their Width.

Add to this, that as their Height or Length is the Dimension taken from the Centre of the Axis; the greatest Dimensions of the new Rectangular Sail, will be turned towards the Axis, and the smallest from it, which is quite contra-

ry to the Position of the common Sails.

The Force of a Wind-mill with 4 of these new Rectangular Sails, Mr. *Parent* shews, will be to the Force of 4 elliptic Sails, nearly as 13 to 24, which leaves a considerable Advantage on the Side of the elliptic ones; yet will the Force of the new Rectangular Sails be nearly 4 Times as great as those of the common ones.

M. *Parent* likewise considers what Number of the new Sails will be most advantageous, and finds that the fewer Sails, the more Surface there will be, but the less Force.

The *Ratio* of the Force of a Wind-mill with six Sails, will be to another with four, nearly as 14 to 13, and the Force of another with 2, will be to that with 4, nearly as 12 to 9.

As to the common Wind-mill, its Force still diminishes as the Breadth of the Sails is smaller, in Proportion to the Height. Therefore the usual Proportion of 5 to 1, is exceedingly disadvantageous.

The Uses of this new Theory of Wind-mills are very obvious.

The more Force a Wind-mill has, the swifter it turns, the more it dispatches, and the less Wind it needs.

To this may be added, that on this Theory, one may have a Windmill, whose Sail shall be a deal less, and yet the Force a deal greater than in the common ones.

WIND-MILL, a Mill driven or turned by the Wind, contrived for the overflowing and watering of *Land*.

Several Mills of this Kind have been used; such as the horizontal Wind-mill, which by a Wheel with Buckets, or Scoops fixed upon Chains, as also, by a Wheel carrying the Water up in Buckets, fixed thereunto, casts the same forcibly from it, by the Swiftneſs of it Motion.

But that is reputed the best made with vertical Sails, like the ordinary Wind-mills, only more in Number, but not so long, placed upon an Axis of a proportionable Length to the Length of the Vanes, the one End resting on a hollow moveable Piece of Timber, that will move round over the Pump as there is Occasion to turn the Vanes, the other End resting on a Semi-circle, in which are several Notches or Stays, so that it may be placed as you please, that be the Wind which way it will, by the Motion of that or the Semi-circle, you will have it at the one Side of the Vanes or the other.

Let the Pump over which one End of the Axis rests, be placed in the Pit or Well, out of which you intend to raise the Water, and the Nose or Mouth of such a Height, as you think fit to convey the Water into a Trough; which Pump may be made of what Diameter you think convenient, according to the Strength of the Wind-mill, and Height that the Water is to be raised.

The Trunk of the Pump may be made round, or if you would have it made large, then a Square may serve as well;

the Bucket must be always dipt into the Level of the Water, which prevents much Trouble and Injury to the Work.

The Handle of the Pump must be extended in Length, to the Axis of the Wind-mill, which must be made crooked to receive and move the same, like to the Axis of a Cutler's Grind-stone, or *Dutch* Spinning Wheel, turned with the Foot; or the End of the Axis of the Wind mill may rest on a Cylinder or Box, made moveable on the Top of the Pump itself, with the crooked Neck or End within the Cylinder; so that when you turn it any way, still the End of the Axis is perpendicular over the Pump.

A Channel also covered or open, must be to convey the Water out of the River into the Pit or Well, wherein the Pump stands, and care must be taken, that the Handle or Rod of the Bucket, be so made, that it may, Swivel-like, turn any way, as you turn your Wind-Vanes, without twisting or otherwise injuring the Bucket; which Wind-mill or Machine, by any reasonable Gale of Wind, will raise a very great Quantity of Water proportionable to its Strength and Weight, with Ease; being made with a small Charge, comparatively, and being not composed of very many Parts, it requires the less Repair, and is less subject to Damage by violent Winds. About 30 Years ago, there was a Wind-mill erected near the *New-River*, between *London*

and *Islington*, with six *Wings*, being the admirable Contrivance of that ingenious Architect Mr. *Surrocole*, in order to convey Water from the lower Ponds, through Pipes under Ground, to a new one made on the Top of the Hill, consisting of an Acre of Ground, which serves successfully to supply the great Increase of new Buildings of *London*, especially to the West-ward; but a sudden Gust of Wind, or rather a Whirlwind, blew it down about 20 Years ago: however it was soon restored: It was also on the 20th of *November* 1720, blown down again, by a terrible high Wind that then happened; but the Proprietors have not thought fit to put up the Sails again, but erected another Mill near it; both which are drawn by Horses.

WINDOWS, *q. d.* *Wind-doors*, are Apertures or open Places in the Side of an Houle, to let in Air and Light.

There are various Kinds and Forms of Windows, Wire Windows, Horn Windows, &c.

Arch'd Windows, Circular Windows, Elliptical Windows, Square and Flat Windows; Round Windows, Oval Windows, Gothick Windows, Regular Windows, Rustick Windows, and Sky Lights.

The chief Rules in regard to Windows, are,

1. That they be as few in Number, and as moderate in Dimensions as may consist with other due respects; in as much as all Openings are Weakenings.

2. That they be placed at a convenient Distance from the Angles or Corners of the Building, because that Part ought not to be open and enfeebled, whose Office is to support and fasten all the rest of the Building.

3. That Care be taken that the Windows are all equal one with another in their Rank and Order; so that those on the Right Hand may answer to those on the Left, and those above be right over these below: For this Situation of Windows will not only be handsome and uniform, but also the Void being upon the Void, and the Full upon the Full, it will be a great Strengthening to the whole Fabrick.

As to their Dimensions, Care is to be taken not to give them more or less Light than is needful; that is, to make them no bigger, nor less, than is convenient; therefore regard is to be had to the Bigness of the Rooms which are to receive the Light: 'Tis evident, that a great Room needs more Light, and consequently a greater Window than a little Room, and *e contra*.

The Apertures of Windows in Middle-sized Houses, may be four and a half, or five Feet between the Jaumbs, and in greater Buildings six and a half, or seven Feet, and their Height may be double their Length at the least.

But in high Rooms, or larger Buildings, their Height may be a Third, a Fourth, or Half

their Breadth more than double their Length.

These are the Proportions of the Windows for the first Story; and according to these must the upper Stories be for Breadth; but as for Height, they must diminish: The second Story may be one third Part lower than the first, and the third one fourth Part lower than the second.

As to the Price of making Windows.] Mr. *Leybourn* says, Window Frames are ordinarily agreed for by the Light; so that if a Window have four Lights, and it be double rabbetted (as the Workmen call it) it may be worth 12 s. that is 3 s. a Light for Workmanship and Materials. But if the Builder find Timber and Sawing, then 1 s. a Light will be enough.

Transom Windows. These Mr. *Wing* says, are worth making (for great Buildings) 1 s 9 d. per Light, or 7 s. per Window. But some Workmen say they have 12, 14, 16 and 18 d. per Light.

Luttern Windows, says Mr. *Wing*; the making and setting up are valued from 9 to 14 s per Window, according to their Bigness.

Some Workmen say (if they saw the Timber) they have commonly 20 s. per Window.

Shop Windows. These Mr. *Leybourn* says, will be afforded at the same Rate as plain or batton'd Doors. See *Doors*.

The Price of Painting.] Mr. *Leybourn* says, the Price of Paint-

Painting is not usually measured, but valued at 3 *d.* 4 *d.* or 6 *d.* *per* Light, according to their Bigness, and Casements, at Three Half-pence or Two-pence *per* Piece, and Iron Bars at a Penny more, if very large.

Windows, says *M. le Clerc*, as well as Gates, differ both in their Bigness, and in their Architecture; the biggest are seen in Churches and Halls, &c. and are usually arch'd to a Semi-circle.

The moderate ones frequently terminate in an Arch less than a Semi-circle. As to the small ones, they are usually long Squares, their Height being sometimes double their Width, or very nearly so.

Both the one and the other are made more or less simple, or more or less rich, according to the Place, and the Architecture of the Buildings where they are used.

In the *Facade* or Front of a Building, the Windows should be exactly perpendicular under one another; and to that End, Care must be taken, that they be all of the same Width; but in different Stories, their Height must be different; those of the lowest and uppermost Stories may be less high, as well as less adorned, than those of the Middle, which are usually for the Master's Story.

The Width of Windows in respect to that of their Jaumbs, *i. e.* with respect to the Breadth of the Wall between Windows, may be as 3 to 4 in temperate Climates, like that of ours; or

as 3 to 5 in Climates that are colder or more hot; or as 3 to 6 in Countries still more exposed to violent Heat or violent Cold; but the various Situations of a Building with regard to *East* and *West*, will always occasion a Variation in the Proportion of Windows themselves.

The Designs of Windows given us by *Vignola*, do very well, as reformed by *M. d'Aviler*, in the Translation he has made of that Author; but it is usual to have Windows much less adorned; and we often make them without any Ornament at all, besides a Plat-band around them, and that too in fine Buildings.

Large Windows should have a Cornish that projects pretty much, to be a Shelter to those who present themselves at them; and in that Case, the Projecture should be supported by two Consoles, as well as the Rest or leaning Place, that terminates the Window at Bottom,

The Consoles of the Cornish should be as big at Bottom as at Top, that they may fall in regularly with the Jaumb and Chambranle.

The Breadth of the Chambranle or Window Frame, may be a sixth Part of that of the Window.

Without the Chambranle is a Plat-band, serving it as an *Arriere-corps*, called a *Montant* or Window-posts, which may have an equal Breadth with the Chambranle, or, on

Occasion, a little less. It serves particularly to place the Consoles of the Cornish upon.

If the Cornish be not supported upon Consoles, this Plat-band should be then narrower by one half, and without any Mouldings besides those that compose its Cornish.

The Consoles that support the Rest or Bottom of the Window, should be plac'd underneath the Chambranle, and be equal to it in Breadth, and the Wreathings may be made to run out on the Sides.

The Height of these Consoles must not exceed half that of the Opening of the Window at the most, nor fall short of a third of that Opening, when the least.

They are usually made narrower at Bottom than at Top; but in *M. le Clerc's* Opinion, it would be better to have them equally big.

The Top of the *Perron* or Ascant, frequently terminates the Bottom of these Consoles.

As for *Windows*, by Statute of 7 of *Queen Anne*, it is ordered as follows.

Whereas it has been the Practice of Workmen to place Window Frames, and Door-cases very near, and quite ranging with the Outside Face of the Wall, whereby they are not only fully exposed to Weather, and thereby decay sooner, than those that are sheltered, by being placed at a moderate Distance within the Walls, but in time of Fire are more liable

to be fired, whereby many Houses may be destroyed; for Prevention of such Practice, it is enacted, that after the first Day of *June* 1709, no Door Frame, or Window Frame of Wood, to be fixed in any House or Building within the Cities of *London* and *Westminster*, or their Liberties, shall be set nearer to the Outside Face of the Wall than 4 Inches; nor shall any Brick-work bear, or be placed upon Timber, or any Sort of Brick-work, excepting upon Plank and Piles where Foundations are bad, on Pain of three Months Imprisonment, without Bail or Mainprize.

But by a Statute made in the 11th of *King George I.* it is made lawful to place Brick-work upon, or over Door Cases and Windows (provided that the Weight thereof is discharged by Arches turned over them) or on Lentils, Breast Summers, Story Posts, or Plates, where required, for the Convenience of a Shop or Shops only.

WITHS. These are used by Thatchers, to bind their Thatching Rods to the Rafter.

They are usually sold at 6 *d.* the Hundred, and one Hundred of them will do about 3 Square of Thatching; they using about 33 or 34 Withs, and as many Thatching Rods (which are of the same Price with the Withs) in a Square; for they bind down their Straw at every Foot or thereabouts, *viz.* at every other Lath (for they lath but two Laths in a Foot) and each Course
of

of Thatching (bound down with one Length of Rods) is about three Foot in Breadth.

WOOD. Great Precautions are to be used in buying of Wood; the Situation of the Place must first be considered: Secondly, The Merchant ought to be perfectly acquainted with the Nature and Quality of it; to observe how the Trees are furnished, and to see that they are thick enough for the Places and Uses they are design'd for: He ought also to have great Regard to the Bargain he makes, in respect to the Time of Payment, that he may make his Money of his Goods, and that he may meet with no Interruption in carrying them off the Ground.

Sometimes the Seller reserves to himself a Number of young Standards for Growth, which are to be mark'd; and therefore the Buyer should make it Part of his Bargain, that in Case any of them should happen to be bruis'd or broken by Accident, he is not to stand to and be answerable for the Damage that way, or otherwise done by the Workmen by Malice or Want of Care, for which the Seller must call them to an Account.

The Merchant likewise ought to covenant for a reasonable Price to clear the Place of the Wood he buys; and that as Woods do not always stand upon or near High-ways, and that many Times there is a Necessity they should be carried away over other Peoples Grounds, the Buyer ought to

oblige the Seller to procure him free Passage for them to the Port, or to which Place he would convey them, without any Molestation or Hindrance.

It would be tedious to enumerate the many Articles necessary to be agreed in such Bargains or Contracts; that is to be left to every one's Prudence and Experience in that way of Dealing.

As for *Forrest* or *Timber-trees*, which are those that are suffered to grow, according to Notion, from 40 to 200 Years; to understand these aright as they are standing, is very different, and more difficult than that of Under-wood; in order to which, the Buyer must first examine the Nature of the Ground where the Forrests are situated; the Sizes of the Trees, and Uses they are designed for.

There are Forrests which the *French* call *Pleine Futages*, wherein the Trees stand so thick, that the Sun cannot penetrate into them, and are situated in a good Soil: Now the Wood had from thence is always of a very tender Nature, by reason of the continual Shade which makes it so, and is only proper for Joinery Work.

But if the Ground where the Forrest grows is sandy and stony, or else gravelly; or if the Trees grow in Hedges, and are fully exposed to the Sun, then you need not hesitate to purchase the Timber for Carpentry-work; for the Wood will be hard, and so fit for that Use.

The usual Time of cutting down

down Wood, is from *Martinmas* to the End of *February*; and many have strenuously contended that it ought to be done in the Wane of the Moon; but it is well known, that the Influences of that Luminary are not efficacious enough to work many of the Effects that are ascrib'd to it, upon sublunary Things.

He who buys Wood or Timber-Trees, must take Care, if they are not very numerous, to observe their Tallness and Thickness, and not content himself with the bare View of them in that respect, but make use of a Cord to measure; and he must likewise observe the Branches, and well weigh what they may yield, and write down a Computation of the whole, that he may take the best Measures he possibly can.

He should have Somebody with him, and beginning at the Foot, measure two Fathom upwards, and when that is done, he may judge of the rest by his Eye proportionably, and so adding the whole together, he will very near ascertain thereby the Height of the Tree.

To know the Thickness of a Tree, take a Cord or Line, with which encompass the Tree; and that if it be six Foot about, fold the Cord into three equal Parts; take off one, and folding the other two remaining ones into 12, in order to take off one Part more; when you have done that, fold the Remainder into four Parts, and you have no more to do than to measure the Length

thereof, and that will shew the Thickness of each Part of the Tree.

WREATHED Columns are usually made very rich, and says *M. le Clerc*, ought never to be used, but in Places of Distinction, as in Altars, Tombs, Salons, and other Places where Magnificence is required.

They should never be used to support either Walls or Vaults, or any other considerable Burden, by reason of their Weakness; nor should any thing be laid upon them, beyond a plain, slight and delicate Entablature: For tho' they appear by their Circumvolutions to have less Delicacy than the common Columns, yet in Effect they have less Solidity.

WYDRAUGHT, a Water-Course or Water-Passage, properly a Sink or Common-Sewer.

X

XYSTOS } among the an-
XYSTUS } cient *Greeks*,
was a Portico of uncommon Length, either open or covered, where the *Athletæ* practised Wrestling and Running. The Word is derived from *Xyon*, *Gr.* to polish; it being their Custom to anoint their Bodies with Oil before the Encounter, to prevent their Antagonists from taking hold of them.

The *Romans* too had their *Xystus*, which was a long Isle or Portico, sometimes roofed over, and other times open, and ranged on each Side with Rows of Trees forming an agreeable Prospect for the People to walk in.

Y YARD.

YARD. A TABLE shewing what Number of odd Feet in a Yard superficial comes to, for any Price by the Yard, from one Farthing per Yard, to 5 l.

		1			2			3			
Superficial Feet.		s. d. q.pts.			s. d. q.pts.			s. d. q.pts.			
The Price of the Yard.	Pounds	1	2	2	2,67	4	5	1,33	6	8	0,00
		2	4	5	1,33	8	10	2,67	13	4	0,00
		3	6	8	0,00	13	4	0,00	20	0	0,00
		4	9	10	2,67	17	9	1,33	26	8	0,00
		5	12	1	1,33	23	2	2,67	33	4	0,00
	Shillings	1	0	1	1,33	0	2	2,66	0	4	0,00
		2	0	2	2,66	0	5	1,33	0	8	0,00
		3	0	4	0,00	0	8	0,00	1	0	0,00
		4	0	5	1,33	0	10	2,66	1	4	0,00
		5	0	6	2,66	1	11	1,33	1	8	0,00
		6	0	8	0,00	1	14	0,00	2	0	0,00
		7	0	9	1,33	1	6	2,66	2	4	0,00
		8	0	10	2,66	1	9	1,33	2	8	0,00
		9	1	0	0,00	2	10	0,00	3	0	0,00
		10	1	1	1,33	2	12	2,66	3	4	0,00
	Pence	1	0	0	0,44	0	0	0,89	0	0	1,33
		2	0	0	0,89	0	0	1,78	0	0	2,66
		3	0	0	1,33	0	0	2,67	0	1	0,00
		4	0	0	1,77	0	0	3,54	0	1	1,33
		5	0	0	2,22	0	1	1,43	0	1	2,66
		6	0	0	2,66	0	1	2,32	0	2	0,00
		7	0	0	3,10	0	1	3,21	0	2	1,33
		8	0	0	3,55	0	2	0,10	0	2	2,66
		9	0	1	0,00	0	2	0,99	0	3	0,00
		10	0	1	0,44	0	2	1,88	0	3	1,33
		11	0	1	0,89	0	2	2,77	0	3	2,66
	Farth.	1	0	0	0,11	0	0	0,22	0	0	0,33
		2	0	0	0,22	0	0	0,44	0	0	0,67
		3	0	0	0,33	0	0	0,66	0	0	1,00

			4			5			6		
Superf. Feet.			s. d. q.prs.			s. d. q.prs.			s. d. q.prs.		
The Price of the Yard.	Pounds.	1	8	10	2,67	11	1	1,33	13	4	0,00
		2	17	9	1,33	22	2	2,67	26	8	0,00
		3	26	8	0,00	33	4	0,00	40	0	0,00
		4	35	6	2,67	44	5	1,33	53	4	0,00
		5	44	5	1,33	55	6	2,67	66	8	0,60
	Shillings.	1	0	5	1,33	0	6	2,66	0	8	0,00
		2	0	10	2,66	1	1	1,33	1	4	0,00
		3	1	4	0,00	1	8	0,00	2	0	0,00
		4	1	9	1,33	2	2	2,66	2	8	0,00
		5	2	2	2,66	2	9	1,33	3	4	0,00
		6	2	8	0,00	3	4	0,00	4	0	0,00
		7	3	1	1,33	3	10	2,66	4	8	0,00
		8	3	6	2,66	3	5	1,33	5	4	0,00
		9	4	0	0,00	5	0	0,00	6	0	0,00
		10	4	5	1,33	5	6	2,66	6	8	0,00
	Pence.	1	0	0	0,44	0	0	2,22	0	0	2,66
		2	0	0	3,54	0	0	0,44	0	1	1,32
		3	0	1	1,32	0	1	2,68	0	2	0,00
		4	0	1	3,10	0	2	0,88	0	2	2,66
		5	0	2	0,87	0	2	3,10	0	3	1,33
		6	0	2	2,64	0	3	1,32	0	4	0,00
		7	0	2	0,42	0	3	3,54	0	4	2,66
		8	0	3	2,20	0	4	1,76	0	5	1,33
		9	0	3	0,93	0	4	3,98	0	6	0,00
		10	0	4	1,76	0	5	2,20	0	6	2,66
		11	0	4	3,53	0	6	0,42	0	7	1,33
	Farth.	1	0	0	0,44	0	0	0,55	0	0	0,67
		2	0	0	0,88	0	0	1,10	0	0	1,33
		3	0	0	0,33	0	0	1,65	0	0	2,00

			7	8	9
Supert. Feet.			s. d. q.prs.	s. d. q.prs.	s. d. q.prs.
The Price of the Yard.	Pounds.	1	15 6 2,67	17 9 1,33	20 0 0,00
		2	31 1 1,33	35 6 2,67	40 0 0,00
		3	46 8 0,00	53 4 0,00	60 0 0,00
		4	62 2 2,67	71 1 1,33	80 0 0,00
		5	77 9 1,33	88 10 2,66	100 0 0,00
	Shillings.	1	0 6 1,33	0 10 2,66	1 0 0,00
		2	1 9 2,67	1 9 1,33	2 0 0,00
		3	2 4 0,00	2 8 0,00	3 0 0,00
		4	3 1 1,33	3 6 2,67	4 0 0,00
		5	3 10 2,67	4 5 1,33	5 0 0,00
		6	4 8 0,00	5 4 0,00	6 0 0,00
		7	5 5 1,33	6 2 2,67	7 0 0,00
		8	6 2 2,67	7 1 1,33	8 0 0,00
		9	7 0 0,00	8 0 0,00	9 0 0,00
		10	7 9 1,33	8 10 2,66	10 0 0,00
	Pence.	1	0 0 3,10	0 0 3,55	0 1 0,00
		2	0 1 2,20	0 1 3,10	0 2 0,00
		3	0 3 4,40	0 2 2,65	0 3 0,00
		4	0 3 3,50	0 3 2,20	0 4 0,00
		5	0 4 2,60	0 4 1,75	0 5 0,00
		6	0 5 1,70	0 5 1,30	0 6 0,00
		7	0 6 0,80	0 6 0,85	0 7 0,00
		8	0 6 3,90	0 7 0,40	0 8 0,00
		9	0 7 3,10	0 8 0,95	0 9 0,00
		10	0 8 2,10	0 9 0,50	0 10 0,00
		11		0 10 0,05	0 11 0,00
	Farth.	1	0 0 0,77	0 0 0,88	0 0 1,00
		2	0 0 1,54	0 0 1,76	0 0 2,00
		3	0 0 2,31	0 0 2,66	0 0 3,00

Explanation of this Table.

Z

First, at the Head of the Table are the odd Feet contained in a Yard superficial, beginning at one Foot, and ending at a Yard.

At the Bottom of the Table you have the Number of Feet in a cubical Yard, numbred by 3, 6, 9, &c. to a Yard solid.

In the first Column on the left Hand, is placed the Price of a Yard, from one Farthing to 5 *l.* per Yard, and in the other Columns under the odd Feet, is the Price in Shillings, Pence, Farthings, and hundred Parts of a Farthing, that any Number of odd Feet come to.

*The Use of the Table.**EXAMPLE 1.*

At 8 d. per Yard, what comes 6 Feet to?

Look for 8 d. in the first Column, and under 6 Feet in the Angle of Meeting, you will find 00 s. 5 d. 1 q. 33; that is, 00 s. 5 d. $\frac{1}{4}$ l. Farthing and 33 hundred Parts of a Farthing, which is the Price or Value of 6 Feet, at 8 d. the Yard superficial Measure.

EXAMPLE 2.

At 5 s. 4. d. $\frac{1}{2}$ a Yard, what comes 8 Feet to?

	s.	d.	q.pts.
8 Foot at 5 s. is	4	5	1,33
8 Foot at 4 d. is	0	3	2,20
8 Foot at $\frac{1}{2}$ is	0	0	1,76

4 : 9 : 1,29

ZOCCO
ZOCCOLO } [*in Architecture*] is a
ZOCLE } small Kind
SOCLE } of Standing

or Pedestal; being a low Square Piece or Member serving to support a Bust, Statue, or the like, that there is Occasion to be rais'd.

The Word is *Italian*, form'd from *Soccus*, a Sandal, or high Shoe.

ZOCCO } also signifies a
ZOCLE } low Square Member serving to support a Column or other Part of a Building, instead of a Pedestal Base, or Plinth.

A continued ZOCLE is a kind of continued Pedestal whereon a Structure is raised; but having no Base or Cornish.

ZOOPHORUS } [*in the ancient Architecture*] is the same Thing with the *Frieze* in the modern.

It was thus called in the *Greek*, because anciently adorned with the Figures of Animals from *Zōon*, an Animal, and *φέρω*, a Bear.

ZOOPHORICK Column, is a Statuary Column; or a Column that bears and supports the Figure of an Animal.

F I N I S.

SUPPLEMENT.

The following are Additions and Corrections communicated to the Compiler of this Work after the Sheets were printed off, therefore not being willing to omit any Thing that may be of Service to the Publick, but to make this Work as compleat as possible, we have inserted them here by Way of Supplement.

I N

M O

IN the Article **INTERTIES**,
for smaller, read larger.

In the Article **JOISTS**, for
10 read 12; for 3 Inches read
6; and for the Word *Furr* read
Bridge.

In the Article **KEYS**, as to
the Price, read from 2 or 3 s.
to 20 s.

To the Article **LATHS**, add
Kentish Laths, which are ac-
counted as good as any are,
about $1\frac{1}{4}$ Inch broad, and a full
 $\frac{1}{4}$ of an Inch thick, one with
the other, and are sold in most
Places of *Kent* for 2 s. 6 d. per
Bundle.

To the Price of laying on
Sheet **LEAD** in Roofing add,
it is now worth 18 or 19 s. per
Hundred Weight.

To the Article **LIME** after
Load of Lime, add: here must
be meant Ruble - Work, for
square Stone-Work takes up

much less Lime than Brick-
work, and the Allowance is
the same as is there mentioned.

To the Article **LINTEL** as
to the Price, add: Carpenters
put in these by the Cubed Foot,
20 d. for Firr and 3 s. for Oak.

To the Article **MORTAR**,
after the Paragraph *How much*
allow'd, &c. add: But if the
Work be done well, it will
take up near two hundred
of Lime.

In the Article **OGEE**, leave
out, or of a round or a hollow,
like an S.

In the Article **PAINTING**,
at Paragraph; *Out Door Work*
instead of 3 d. &c. read, from
5 d. to 7 d. the Yard square.

In Paragraph, *Gates and out-
ward Doors*, instead of 3 d. &c.
read from 5 d. to 6 d. per Yard,

In *Sash Lights*, for 1 s. read
1 d.

In *Sash Frames* read from 1 s. per Frame to 2 s. 6 d. per

In the Article **PALEING**, add; (that they cleave only that Part of the Timber which is without Knots; but when they saw, they saw Knots and all; and for this Reason they can make it a great deal more by sawing than cleaving.

To **PAVING**, with *Rough* or *Rag-Stone*, add: 1 or 4 d. per Yard Workmanship.

PEERS; instead of this Article, read,

PEER [in *Architecture*] a solid Wall between two Doors or Windows; also a short square Pillar, with Base and Capital, plac'd before a Gentleman's House for Ornament, and differs from a Pilaster in this, that they are shorter, and the Base and Capital are the same that Architects give to Pedestals.

In the Article **PILES**, after mortois'd, add tenon'd.

PLANE. Instead of the Articles *Plane* in the Dictionary, take these that follow.

P L A N E S have various Names, according to their various Forms and Uses.

The *Fore Plain* (or as the *Dutch* call it, the *Fore Loper*) is about 18 Inches long; is the first used to take off the greater Irregularities of the Stuff, to prepare it for the *Trying Plane*, or, the *Long Plane*; the Edge of its Iron is ground with a Convex Arch, to bear being set the ranker.

The *Trying* or *Long Plane*, is about two Foot long; its Use is to make the Work strait, and prepare it for the Jointer.

The *Jointer* is the longest of all, about $12\frac{1}{2}$ Foot long; the Edge of its Iron being very fine, its Use being to join two Boards together, and make both Edges perfectly strait and fit to glew.

It has been often said by some good Workmen, that there is nothing to be made perfectly strait, round or square; yet I believe a very curious Workman may do either of them, and demonstrate them to be so, as for Instance to make a Board strait.

Take two thin Boards, about three or four Foot long, more or less, and shoot them both together with a good Jointer till they will join and be close every way, which may easily be done by a good Hand. Then will both Edges of these Boards be perfect strait Lines, for otherwise they would not join and be close.

The *Smoothing Plane* is a short Plane about six or seven Inches long: its chief Use is to smooth and finish the Work.

The *Strike Block* is a short Jointer, about 13 or 14 Inches long, to join Mouldings and short Work.

The *Rabbet Plane*: The Iron of this Plane is full as broad as the Stock, that the Angle may cut strait, and it delivers its Shaving at the Sides, and not at the Top like other Planes; its Use is to make Slopes of Right Angles in the Edge of a Board, and Fillets in Mouldings, as the Anulets in the *Doric Capital*, &c.

The *Plow*. Its Use is to plow narrow square Groves in the

the Edge of a Board to receive the Edge of a thinner Board as the Edges of the Framing is plowed to receive the Edges of the Panneling in a Room of Wainscot.

Moulding Planes are of various Kinds, accomodated to the various Forms and Profiles of the Mouldings.

Round and Hollow Planes, are of several Sizes, from half a Quarter of an Inch, to two Inches and upwards; and curious Workmen have 16 Pair of these Planes, each differing half a Quarter of an Inch, with which, and the Snipes Bill and Rabbet Plane, they Work the various Sorts of Mouldings.

In the Article POINT, to the End, add, or Beginning of Magnitude.

Instead of the Article PUNCHINS, read, they are those that are plac'd next a Door or Window, and are called Door or Window Punchins.

In the Article inclin'd PLANES, for *Oblique* read *Oblique*.

In the Article the PULLEY, in the Article 3. *If a Power applied in B*, &c. in the 3d Line of the second Column, for G E read G F; in Line 8, for F L read E L and in Line 9, for B read F.

In Article RAILS, add; But the Price of these is various, according to the Workmanship.

RAISING Pieces [in Carpentry] are those Pieces that lie on the Tops of the Post and Punchions, and under the Beams; those that lie on

Brick-work, and under the Beams, are called Platbands.

In the Article RHOMBOIDES, in Column 2, Line 9, for A B C, read A B C D; and Line 18, for B C read D C; and Line 21, for C B E, read C B F.

In the Article ROOFS, in the Sheet whose Signature at the Bottom is P, in the second Page, and second Column, and second Line, for *Carvings*, read *Furrings*; and after Line 20, the six Particulars beginning 1 Chamber Beam, and ending 6 Battlements, do all belong to the Article, entituled Flat-Roofs, Plate 3, and are immediately to follow the End of that Article, the last Line of which is; *Drips may be made to walk on*.

To the Article SAND, add, Pit-Sand is much inferior to River-Sand, because not purged; Sea-Sand is the worse because salt; but that Sand taken from *Barkin-shelf*, which is between fresh and salt, will make good Mortar, as I have proved my self.

In the Article SELLS, add, the Rates or Prices before-mentioned are to be understood only of small Buildings: for putting in Sells to large Houses in *London* is very dear Work, the Price of which cannot be ascertained.

In the last Paragraph, just before STAIR CASE, immediately after the Words; *by the Number of Stairs*, add the following Words; *less by one; for the last Rise-up is not to be accounted in the Breadth*.

At the latter End of the Article Stair-cases, add, tho' these Sort of Elm-Stairs were much in use after the Fire of London, and might be the Price at that Time; yet the Price of Stairs cannot be ascertained, there is so much Difference in the Goodness of the Workmanship.

To the Article SUMMER, add, *Summer in Carpentry* is a large Piece of Timber to which the Girders are fram'd.

Price of plain Tiling in

London (is 25 or 26 s. per Square, Rippling Old Tileing is worth from 14 to 18 s. per Square, according to the Goodness of the old Tiles.

Pan-tiling pointed is worth 1 l. 0 s. 6 d. plain Ditto 18 s. ript 10 s. Dutch glaz'd 1 l. 15 s. English Ditto 1 l. 10 s.

Those who have no mind to make use of the Tables for Tileing, &c. may find the Price or Value by this easy Method.

Admit a Piece of Tileing to be 46-8 Inches long, and 32 Foot broad, at 26 s. per Square; *What is the Amount?*

46-8

32

14.93-4
26

Which is 14 Square, 93 Foot and 4 Inches, which multiply by 26 s. the Price.

8958

2986

8-8

388.26:8

Which is 388 Shillings and $\frac{1}{2}$, the 8 Parts not worth regarding in this Case = to 19 l. 8 s. 3 d.

Reduce the $\frac{1}{2}$ by the Rule aforegoing.

26

12

52

26

Which is 3 d. and near $\frac{1}{2}$ of a Penny not worth regarding.

3.12

4

48

Another

At the last End of the Article State, and the Value of a Piece of Tiling. Another Example to find the Value of a Piece of Tiling.

Suppose a Piece of Tiling to be 35 Foot 7 Inches long, and 22 Foot deep.

$$\begin{array}{r} 35-7 \\ 22 \\ \hline 770 \\ 12-10 \end{array}$$

Which is 7 Square 82 Foot 10 Inches, at 27 s. 6 d.

$$\begin{array}{r} 5474 \\ 1564 \end{array}$$

$$\begin{array}{r} 22-6 \\ 391-0 \end{array}$$

Which is 10 s. 15 d. 3 1/4

$$\begin{array}{r} \text{Shillings } 215.27-11 \\ 12 \end{array}$$

$$\begin{array}{r} 54 \\ 27 \\ \hline 11 \end{array}$$

$$\begin{array}{r} \text{Pence } 3.35 \\ 4 \end{array}$$

$$\begin{array}{r} \text{Farthings } 1.40 \end{array}$$

See

See how it will answer with the first Example.

	<i>Feet.</i>
A Square is	100
Three Quarters	75
Half	50
A Quarter	25
18 Feet	18

268 Which is two Square, 68 Foot at
14 s. per Square

2.68

14

1072

268

37.52

11

104

52

6.24

4

.96

Which is 37 Shillings, and $13\frac{1}{2}$, which reduced, is = to 1 l. 17 s. 6 d. $1\frac{1}{2}$, almost a Farthing.

This Method is more exact than the Tables, very easy, and with much less Trouble, and I believe will be acceptable to those whose Hands it may fall into.

To the Article TIMBER, add, How much Timber will compleat a Square of Building? *Answer*, Twenty Foot of solid Timber will compleat a Square or 100 Feet of ordinary House Building, one Part with the other.

But large and massive Framing may take up double or treble that Quantity, and slight Framing may be done with less.

In the Article TIMBER, and in the Paragraph *Felling*, add, *Felling* Timber, and cutting the

the Top Wood, is from Two Shillings and Six Pence to Three Shillings and Six Pence, and hewing about Two Shillings.

In the Example 1. of Timber, for Sum 1 l. 03 s. 05 d. read 1 l. 17 s. 05 d.

In the Sheet whose Signature at Bottom is D d, and Article, *If a Wall be 104 Feet 9 Inches, &c.* mind not the working in that Page but this which follows.

$$\begin{array}{r}
 104-9 \\
 17-3 \\
 \hline
 728 \\
 104 \\
 12-9 \\
 26-2-3 \\
 \hline
 272 \text{) } 1806-11-3(6 \\
 1632 \\
 68 \text{) } 174(2 \\
 136 \\
 \hline
 38
 \end{array}$$

Answer, Six Rods $\frac{1}{2}$ 38 Foot, 11 Inches, 3 Parts.

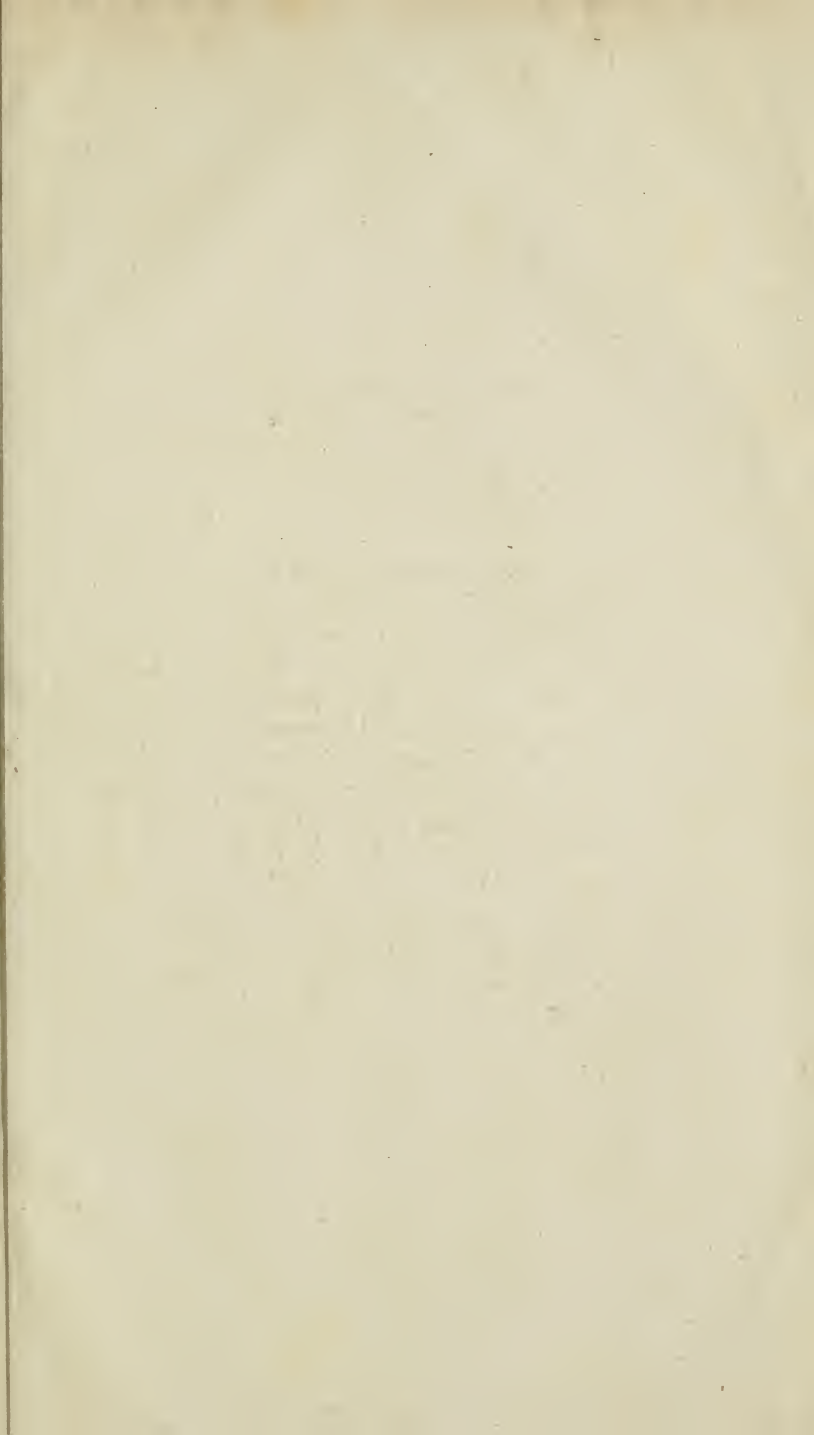
N. B. We hope the Reader will make all proper Allowances in the Prices; as better Workmanship or Materials may exceed the Schemes of our Computations.

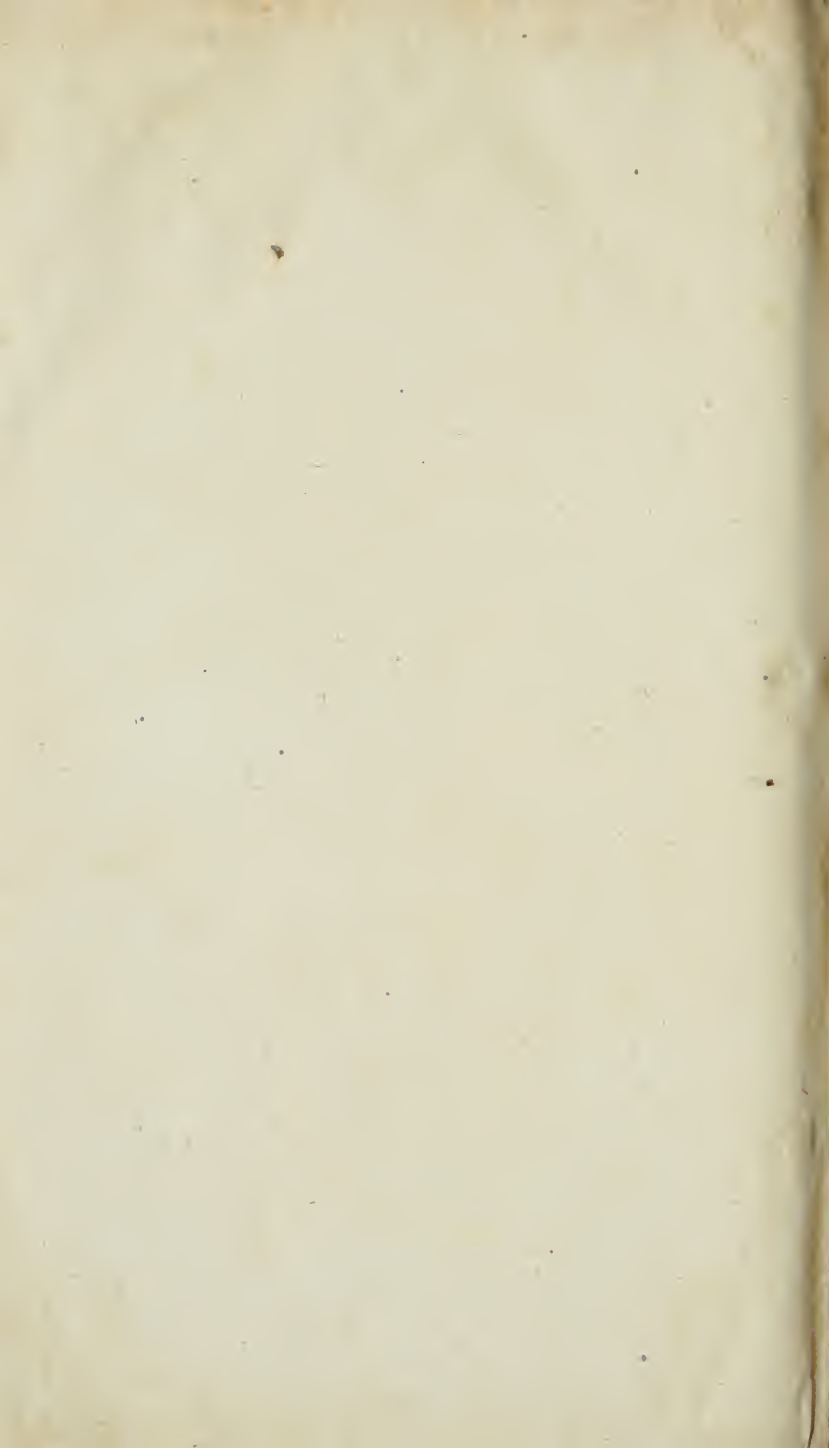
F I N I S.

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